APPLETONS'
POPULAR SCIENCE
MONTHLY.

SEPTEMBER, 1896.

PRINCIPLES OF TAXATION.

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III.—THE DEFINITION, OBJECT, AND SPHERE OF TAXATION.

IT would seem to be in the nature of an economic or common-sense axiom, that a large and varied experience in respect to the management of any one of the great departments of the world's business, would result in the gradual evolution and final definite establishment of certain rules or principles, which would be almost universally recognized and accepted as a basis for practical application and procedure. But in respect to the matter of taxation—which is a fundamental necessity for the maintenance not only of all government, but of civilization—no such result has been achieved. In no department of economic science is there, moreover, so much obscurity and conflicting opinion. Most economists teach that there is "no science of taxation as there is a science of exchanges"; and "that there are no great natural laws running through and controlling taxation and its effects." And while the student will find examples in the history of states or governments of the practical application of almost every form of appropriation of private property under the name of taxation which human ingenuity, prompted by necessity, selfishness, or greed, could devise,* and a sufficient record

* "In Austria everything, it is said, is taxed except the air, and even that has to be paid for in places famous for their salubrity. Dogs, cycles, newspapers, advertisements, and innumerable other articles—pleasures and necessaries—are included in the money-producing list; nothing, indeed, seemed excluded until a very short time ago, when a provincial financier forwarded an exhaustive report to the finance ministry on a neglected source of

of effects to warrant the drawing of general and correct inferences, it is nevertheless probably true that there is not, at the present time, a single existing tax, decreed by despotism, or authorized by the representatives of the taxpayers, which has been primarily adopted, or enacted *solely* with reference to any economic principles, or which has sought to establish the largest practical conformity under concurrent circumstances to what are acknowledged to be the fundamental principles of equity, justice, and rational liberty. But, on the contrary, the influence of temporary circumstances, as viewed, in most instances, from the standpoint of a governmental administration—despotic or republican alike—desirous of retaining power, has ever been the controlling motive in determining the character of taxation; or, as Colbert, the celebrated finance minister of Louis XIV, is reported to have expressed it, in saying that "the art of taxation consists in so plucking the goose [i. e., the people] as to procure the largest quantity of feathers with the least possible amount of squawking." Hence, apart from its methods of distributing power and patronage, the popular idea of evil, as connected with government, may almost always be referred back to unequal or excessive exactions; and to the reality of which, as evils, more than to any other one agency, may be referred most of the world's political revolutions, and the ferocity with which, as was notably the case in France, they have been often conducted. Hence,

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revenue—cats. The horse, the ass, the goat, the hog, the chicken, the dog, the goose—all contribute their mites to the support of the state, said this financial reformer. The cat alone is a parasite, paying nothing to any one and preying upon every one. But is the project really practicable? Certainly it is, replies its author, and he forthwith sets himself to prove it. Every cat for which the tax—a rather heavy sum—is paid, would receive an official colored ribbon for its neck, with a number and a government stamp. Every feline defaulter found without this ribbon would be seized and temporarily confined in the Cats' Home. If not redeemed before the lapse of a fixed term—say eight days—it would be sold or poisoned by the state."

"A tax on beards was in operation for a long time and under various forms in Russia. Peter the Great, knowing the attachment that his subjects had for the hirsute adornment of the face, introduced a tax upon the beard in his empire. The beard is a superfluous and useless ornament, said he, and, starting from this principle, he imposed a tax upon it as an article of luxury. This tax was proportional and progressive, not in proportion to the length of the beard, but to the social position of those who wore it. Each person upon paying his tax received a token, which he had to carry upon his person, for the guards were nexorable, and, always provided with scissors, ruthlessly cut off the beard of those who could not show their badge."

"Catharine I confirmed this tax. In 1728 Peter II allowed the peasants to wear a beard, but kept up the tax for the other classes under the penalty of work on the galleys in the case of non-payment. Czarina Anne rendered life still harder to bearded men, for not only were they obliged to pay the special contribution imposed upon them, but also had to pay a double tax upon everything else for which they were assessed. This tax was not abolished until the reign of Catharine II (1762–1798)."

also, the preference almost always shown, on the part alike of those who enact and those who pay taxes, for *indirect* taxation, which very successfully blinds the taxpayer as to the amount which he pays and as to the time and place of its collection; and hence, finally, the idea, which has come to be all but universally entertained, that taxation *per se* is in itself an evil—something to be avoided, if possible, and an escape from which is always "good fortune."

A QUESTION OF PRIME IMPORTANCE, therefore, which confronts us at the outset in entering upon any discussion of this subject is, Are these assumptions of economists that there is no science of taxation and no general laws regulating its exercise and effects—assumptions generally concurred in by jurists and popular sentiment—correct? If they are, then there are no principles of taxation to discuss, and a consideration of the subject must be limited mainly to a recital of the world's experiments and experiences and an exposition of legislative enactments and court decisions. To admit their correctness, furthermore, is equivalent to confessing that human knowledge, in at least one department, has reached its extreme limit; and that a class of transactions which, more than almost any other, are determinative of the distribution of wealth, the forms in which industry shall be exerted, and the sphere of personal liberty, are best directed by accident or caprice. To ascertain the true state of the case ought, accordingly, to constitute the main object of inquiry, and, with a view of helping to the formation of an intelligent opinion, attention will be first asked to the meaning or definition of the two fundamental terms, *tax* and *taxation*. And in so doing we obtain immediately an illustration of the indefiniteness of idea and lack of exactitude in expression that characterize this whole subject, and also a very definite clew to their origin.

ANALYSIS OF THE WORD TAX.—Thus, the word *tax* in the English language, and its equivalent in all other languages, is used in a very loose and indefinite sense. Many writers, and the dictionary-makers generally, use the word in an extremely generic sense, to cover and designate all contributions obtained by process of assessment and levy (act of collection) by a state or government from the persons and property of its citizens; or from persons and property within its power and jurisdiction; in whatever form, or however arbitrary the assessments or levies may be, and by whatever name they may be known or designated—whether tribute, toll, talliage, duty, gabel, customs, impost, poll, subsidy, aid, excise, income, or benevolence.* Such a

* "A tax is a rate or sum of money assessed on the person or property of a citizen by Government for the use of the nation or State."—*Webster's Dictionary.*

definition, however, which makes no distinction between contributions levied at his unrestrained will or caprice, and for any purpose, by a bandit whom circumstances have raised to the head and government of a petty tribe or community; or by an absolute and ignorant Oriental potentate, like Ismail Pasha, Khedive of Egypt (1863–'79);* or by a European monarch, like Louis XIV, who said, "I am the state," and those contributions which represent that part of the wealth of a state which is taken from its citizens with their free consent for exclusive public purposes, in accordance with a well-defined and intelligent public policy; a definition that recognizes no distinction between these two methods and objects of taking, obviously can not be scientifically correct; for there can be no more analogy between the two methods than between a payment for value received and an act of highway robbery.† Obviously, also, there can be no science of taxation predicated or formulated on such a definition, for there can be no science of irregularity and arbitrary action.

Again: "So long as people use words which have no precise signification, which may be interpreted in a variety of ways, and which present at once to the mind different ideas more or less obscure, more or less mixed up with one another, there will be uncertainty in the theory, or rather there will be a vague, incomplete, and ill-co-ordinated theory; and then, as all practice is the application of a theory, the practice resulting from it will be faulty."—*M. Menier.*

The celebrated French economist above quoted also makes the following well-warranted criticism on the current definitions of taxation: "They have," he says, "one general fault: they try to point out the employment of taxes, but they do not show the origin of taxes."

What, then, will be a correct definition of a tax?

"The definition of both Webster (Daniel) and Story (Justice) is, that a tax is a contribution imposed *by Government* on individuals for the service of the State."—*Miller, on the Constitution of the United States*, p. 235.

"Taxes are defined as the enforced proportional contribution of persons and property levied *by the authority of the State* for the support of the Government and for all public needs."—*Cooley on Taxation*, p. 1.

"A tax is a portion, or the value of a portion, of the property or labor of individuals taken from them by Government and placed at its disposal."—*J. R. McCulloch.*

* The revenue annually exacted, under the name of taxation, by Ismail Pasha, especially during the latter years of his reign, from an exceedingly poor population a little in excess of five million in number, was reported to have been about $75,000,000.

† Despotic rulers in all ages of the type of Louis XIV, the Khedives of Egypt, the Sultans of Turkey, and the Czars of Russia have undoubtedly regarded their expenditures of money exacted under the name of taxation from their subjects for the maintenance of great armies, harems, mistresses, pensions to favorites, and the like, as for legitimate public purposes.

It is not easy to frame such an one, in clear and succinct language, covering all the essential conditions. It probably never has been done, and therefore the best thing to do is not to spend time and effort in attempting it, but rather to endeavor to illustrate and point out its meaning indirectly. And, with this purpose in view, it is important to recognize at the outset an exact and homely truth, and one which heretofore has been generally overlooked by writers on taxation and political economy, namely:

That a government never has any money—by which alone the expenses of the state can be defrayed—except what the people—citizens or subjects—give, or concede to it by voluntary or involuntary action; and that the people, as a whole and in turn, never have any to give except what comes to them as the result of their work, or from an exchange of the products of their work. And such being the case, it follows, as has been happily pointed out by Mr. Atkinson, that what the Government really wants of its people, when it calls upon them for taxes, is work, and that the methods of taxation are only methods for collecting and using the products of work.* Hence the following definition of a *tax*, deduced from the above statement of fact by Mr. Atkinson—that "*it is that certain portion of the product of a country which must be devoted to the support of the Government*"—embodies a meaning and a truth not incorporated and set forth in the ordinary or popular definitions. At the same time it is deficient in not recognizing any distinction between a just and uniform taking and an exaction or confiscation.

TAXATION IN THE UNITED STATES, ITS AGGREGATE AND DISTRIBUTION.—During the year 1890 the aggregate revenue receipts of the several governments of the United States, derived mainly from taxation, as reported by the census of that year,† were $1,039,482,013, apportioned as follows: Federal taxation, $461,184,680; State taxation, $578,328,333. The last aggregate was again subdivided into $116,157,640 for State purposes, including the Territories and District of Columbia, $133,525,493 for county pur-

* "Taxation means work, of the head, of the hand, or of the machine, or all combined. And the method of taxation is only a method of distributing the products of work. It is measured, when in the process of distribution, in terms of money, but the money itself stands for work, or is derived from work. And the work of the Government is as much a part of the work of the community as any other. All who work, from the head of the nation down to the lowest municipal official, must be supplied with shelter, food, and clothing; and those who pay the taxes do the work that is necessary to furnish this supply."—*The Industrial Progress of the Nation, Edward Atkinson;* Putnam, New York, 1890. *Taxation and Work, same author.*

† The census of 1890 presented for the first time even an approximation of the annual incomes of the several governments of the United States, and the amount and objects for which they were expended.

poses, and $329,635,200 for municipalities and schools. If a temporary and extraordinary charge for pensions—$140,959,361 in 1895—which now rests upon the Federal Government, were eliminated, and Federal expenditures were reduced correspondingly, the taxation and expenditures of the national or Federal Government would be small in comparison with the total cost of all government, Federal and State; a result that constitutes a complete refutation of the common assumption that the national Government is rapidly absorbing the functions of the State and local governments and reducing them substantially to police precincts. Of the Federal revenues, nearly one half under the existing fiscal system are derived from taxes on distilled spirits, fermented liquors, and tobacco, all of which may be fairly regarded as self-imposed.

If we assume, as we are probably warranted in doing, the average value of the product of each person in the country *who is occupied for gain*, at six hundred dollars per year,* or two dollars per day for three hundred working days, then that part of the annual product of the country which went to the support of its Government or the State in 1890 was the equivalent of the work of 1,734,121 such persons for one year, or 520,236,300 days' work; or, in other words, for every dollar that the Government expends, somebody must work for at least half a day, or furnish a value equivalent for such an amount of work. Again, for the year 1890, the aggregate of taxation in the United States—national, State, and local—required or represented about seven per cent of the value of the entire annual product of the country, which probably approximated $1,200,000,000. In former days it was often customary to allow persons to pay their taxes by actual days' work, and this is still the practice in some parts of the United States and in Canada and some countries of Europe. Before the French Revolution, the tax imposed on the French peasantry, and known under the name of *corvée*, as has been already shown, was an obligation to render a specified number of days' work to the state, or to some seignior or noble. During the early colonial days of Massachusetts, the people of the settlements far removed from Massachusetts Bay paid their proportion of the expense of maintaining a colonial government at Boston in wheat, which was shipped down the Connecticut River in canoes, and then transferred to sailing craft and transported by sea to Boston. One could hardly imagine the disturbance and excitement that would be occasioned if all the taxes of the country were to be collected in this

* The most recent investigations of Mr. Atkinson, the best authority on this subject, have led him to the conclusion that the average value of the product of each person in the United States, working for gain three hundred days in the year, was in 1890 nearer $700 than $600 per annum.

way, and if the head of every family was compelled to perform annually some twenty days' labor to discharge the obligation incumbent on himself and family to pay taxes, which would be about the amount which the head of every family in the United States would have to perform to meet its present annual expenditures. Everybody would then be talking economy; and the politician who wanted votes, instead of promising public buildings, or more salaried offices to his constituents, would say, "Gentlemen, give me your votes and elect me, and I will have your compulsory labor cut down next year from twenty-five days to twenty, or even fifteen." And yet the difference between that state of things and the present is merely a difference of appearance.

WHAT IS TAXATION?—The popular or dictionary definition of taxation—namely, "the act of levying a tax or imposing taxes"—is as indefinite and imperfect as the ordinary definition of a "tax" has been shown to be. Scientifically considered, taxation *is the taking* or appropriating such portion of the product or property of a country or community as is necessary for the support of its government, by methods that are not in the nature of extortions, punishments, or confiscations; and a systematic and orderly arrangement and presentation of the knowledge gained by experience and discussion, with a view to effect such a result with certainty, uniformity, and the minimum of cost and trouble to society and its individual taxpayers or contributors, constitutes the *Science of Taxation.**

In what will be hereafter said, the word *taxation* will be used as far as possible in the sense in which it has been defined; but at the same time the employment of the unscientific term has become so general that its use in default of any satisfactory synonym is almost unavoidable, especially in the historical treatment of the subject.

Such a limitation of the meaning and nature of the word *tax* as has thus been given is clearly of the first importance, and a lack of its recognition is undoubtedly responsible in a high degree for the present unsatisfactory position of the subject of taxation as a department of economic knowledge; and also for a very general belief that in determining the forms of taxes the only rule to be followed is that of expediency. It may be too much to claim that a general recognition and practical acceptance of the proposed definitions and limitations are absolute essentials for the concep-

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* Essentially the same definition of taxation has been given by Mr. J. R. McCulloch. "It is," he says, "the name given to the branch of the science of political economy which explains the mode in which different taxes affect the public interest, and in which the revenue required for the public service may be most advantageously raised."—*Treatise on the Principles of Taxation, J. R. McCulloch, 1875.*

tion and construction of any just and intelligent system of taxation, and also for any such collocation of general truths relative to taxation as will raise the subject to the dignity of a science. But, be this as it may, it seems certain that such recognition and acceptance would at once sweep away many obstacles that would otherwise stand in the way of such a consummation, and bring a high degree of order into what is now a comparative chaos.

And, as one illustration of this, consider how entirely, and yet how naturally, the proposed definitions and limitations change the generally accepted idea of the relation of a tax to the individual taxpayer.

As has been already pointed out, the popular idea of a tax is that it is always an evil. Most writers also on political economy, in discussing the subject, start with the idea that the act or exercise of taxation necessarily implies perpetual antagonism between the state, the sovereign, or the executive, and the private citizen. The parties concerned are the citizen on the one side and the state on the other, and the former being comparatively weak and the latter exceedingly strong, the state is always assumed to get the upper hand. M. Proudhon, in his work *Théorie de l'Impôt* maintains that "all taxes are iniquitous," and that "if a sole tax was established it would be the sum of fiscal iniquities." "There are no taxes," says Ricardo, "which have not a tendency to lessen the power to accumulate." J. B. Say, the eminent French economist, declared that, by whatever name known, taxes are always a burden upon the private citizen. M. Garnier, another French economist, defines taxes "as the reduction made on the private fortunes of the citizens by the Government to meet public expenditures." According to John Stuart Mill, "it is impossible in a poor country to impose any tax which will not impede the increase in the national wealth."

"None of us feel, when the tax-gatherer comes, that to be taxed is a favor; or that, as to the money exacted, we as individuals are the better off for its having been taken from us. We know the tax is a burden; as such it is recognized by every person upon whom it is imposed."—*Hon. Thomas M. Cooley.*

All such conceptions of the position of the state in respect to the taxpayer are, however, monarchical, implying the relation of master and subject, lord and serf;* and from such a point of view

* When the Jewish people, weary of the tax despotism of a sacerdotal class—i. e., the tribe of Levi, to whom the land was held to have been given by Jehovah—manifested an intention of setting up a king, the prophet Samuel foretold that under royalty taxation would be still more oppressive, and "this," he said, "will be the manner of the king that shall reign over you. He will take your sons and appoint them for himself, and set them to ear his ground and reap his harvest; and he will take your daughters to be cooks," etc.; "and your fields, and your vineyards, and your olive-yards, even the best of them; and the

this general idea of antagonism between the taxpayer and the government is correct and has been in accord with the great mass of the world's experiences. In fact, these conceptions undoubtedly originated with the first or old economists, who, living under arbitrary, despotic governments, and unable to comprehend the modern ideas respecting personal liberty and a free government, came to the only conclusion respecting the nature of taxation that their limited sphere of observation and experience would permit.* And so to-day, under an absolute government, the interests of the sovereign—czar, sultan, emperor, king, whatever name he bears—are always in a greater or less degree in antagonism to those of the nation, and these same conceptions have also to a large extent been generally accepted in states whose form of government is not monarchical, but free or popular, as in the United States, where, through lack of intelligence or interest on the part of the general public and of the law-makers, systems for raising revenues have been built up and tolerated which almost without exception are unjust in their administration and incidence. When an eminent lawyer and member of the Constitutional Convention of the State of New York in 1867–'68 stood up before that assemblage when the subject of taxation was under consideration and said, "I insist that a people can not prosper whose officers either work or tell lies—there is not an assessment roll now made out in this State that does not both tell and work lies," † no man gainsaid him, for no man who had ever given any attention to the subject could.

But such conceptions are not true of taxes levied under a popular form of government, and in accordance with conditions essential to justify their right to be called taxes; for there is no one act which can be performed by a community which brings in so large return to the credit of civilization and general happiness as the judicious expenditure, for public purposes, of a fair percentage of the general wealth raised by an equitable system

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tenth of your seed, of your sheep, and your goodliest young men and put them to his work," etc. And the prediction then made was verified, as under like circumstances it has always since been.

* With the old economists the state always preponderates. It is the master of the citizen instead of being merely the steward of the nation. "It addresses the citizens imperiously. They are its *contributables*, and must pay. According to such doctrine, life is a tollgate. They must give so much a head for the right of living in the country. Man is the debtor of the state. Man pays, not the commodity, and the citizen remains the serf of the state."

"Under monarchical right, taxation is speculation by the king upon the people. In a word, there is an antagonism between those who pay and those who levy taxes. Taxation is the expression of that antagonism."—*M. Menier.*

† Speech of Hon. M. I. Townsend, Delegate at Large, Constitutional Convention of New York, 1867–'68. Proceedings and Debates, vol. iii, p. 1945.

of taxation. The fruits of such expenditure are general education and general health; improved roads, diminished expenses of transportation, and security for life and property. And it will be found to be a general rule that no high degree of civilization can be maintained in a community, and indeed that no highly civilized community can exist, without comparatively large taxation;* the converse of this proposition, however, at the same time not being admitted, that the existence of high taxes is necessarily a sign of high civilization.

It is interesting to note, however, that as civilization increases, and taxation becomes absolutely greater, it also becomes relatively less. Thus, in most of our great cities the cost of the water supply to its inhabitants constitutes at present one of the largest items of municipal expenditure—an item that forty or fifty years ago hardly found a place in municipal accounts. And yet the cost of a supply of even the minimum quantity of water now regarded as essential to meet the ordinary requirements for personal cleanliness and health would be very much greater to every citizen, were he to undertake to supply himself, even if it were possible, by the old methods; to say nothing of the comfort and luxury, as well as protection against loss by fire, which an increased supply, made possible only through a greatly increased aggregate of taxation, has afforded.

In short, taxation assessed and levied under conditions clearly conformable to reason and justice, is no more of an evil than any other necessary and desirable form of expenditure. Its proper exercise does not diminish, but protects and augments, national wealth, and is no more a burden upon the people of a state than the payments made for the care and profitable management of private or corporate investments of capital are a burden upon the owners of such capital. Indeed, M. Menier, whose study of taxation entitles him to be regarded as an authority, contends that the analogy between the expenditures of a state which have to be remunerated by taxes and the expenditures of a manufacturer is most complete. The state, he says, possesses a certain extent of territory. That territory has such and such natural utilities. These natural utilities have been developed by labor

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* "I have not seen an instance of rent being very low, and husbandry at the same time being good."—*Lowe, quoted by McCulloch.*

"It is universally found that the low rents absorb the largest proportion of the product."—*H. C. Carey, On Wealth, p. 341.*

"An ingenious philosopher has calculated the universal measure of the public impositions by the degrees of freedom or servitude that accompany them, and ventures to assert that, according to an invariable law of Nature, it must always increase with the former and diminish in a just proportion to the latter."—*Statement by Gibbon, on the authority of Montesquieu.*

or appropriated by man, and the capital of the nation is the *ensemble* (the whole) of the utilities it possesses. In the case of a private person the conditions are the same. His capital is the *ensemble* of the utilities he possesses. The result which he, equally with the state, seeks to attain, is the same—namely, to make the capital which they control fructify to the greatest possible extent for the benefit of the citizens of the state on the one hand and the individual on the other; and between the expenditures which it is necessary to incur for the attainment of these ends on the part of the state and the individual there is no essential difference. And from this analogy, thus urged to identity, M. Menier deduces the following definition of taxes:

They represent, he says, *the investment of the capital of the nation, or state, and the general expenses of its care and development.**

It is obvious, however, that M. Menier's analogy would not hold good under a system which failed to recognize any difference between a tax and an arbitrary exaction.

"So far as it is necessary for the security of person and property, money spent for the support of government is as usefully expended as is the purchase of clothing or provisions; but when the sum taken exceeds what is required for that purpose, it is only a question of amount between the sovereign of India, who exacts one half of the produce, and the legislator of Great Britain or the United States, who exacts a million of pounds or of dollars for which an equivalent is not given."—*H. C. Carey, On Wealth, p. 343; Philadelphia, 1888.*

An almost self-evident corollary from these sound deductions would be, that any tax or system of taxation that did not protect but diminished private property would tend to imperil or dry up the sources of public revenue.

A recognition of the true relation which a just and equitable system of taxation sustains to the state and to the capital or property of its citizens, and also of the fact that under such a system a tax *works to a diminution of the income of the property taxed, and not to a diminution of the value of the property itself,* ought

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* M. Menier, in proposing the above definition, himself recognized the necessity of accompanying it with the following explanation: "When I say that taxes 'represent the investment of national capital,' it is of course understood that I speak only of that of the investment assigned to the state, and that I am very far from the communistic theory, according to which the state, being the owner of the national capital, should turn it to account for its own profit. In the useful employment of the capitals of the nation there are an individual part and a collective part. In my definition of taxes only that collective part, the syndicate contribution, is taken into account."—*A Treatise on the Taxation of Fixed Capital, by M. Menier, of the French Chamber of Deputies. English translation, by I. O. Gallegan, Fellow of the University of France; London, 1880.*

to effectually expose the fallacy of the somewhat popular idea, that taxation is really a *gradual* (and in the course of time a complete) confiscation by the public of all private or individual property; and that in a certain sense no man by reason of taxation can be regarded as having a perpetual ownership of any property; an annual tax on the value of any property of one and a half per cent, with five per cent interest, exhausting such value in about *thirty* years. If taxation brought no returns, either direct or indirect, to the persons or property assessed, there would be some warrant for regarding it as an act of confiscation; but if it provides, as every correct system of taxation does, for a certain class of expenditures, in default of which in the present state of society there would be no adequate protection to property and no encouragement for its accumulation and development, then there is no more reason for regarding taxation as confiscation than for attributing the same effect to payments for wages, rents, repairs, interest,* insurance, etc.

A practical illustration of the truth of this conclusion is to be found in the circumstance, that as a rule the class of property paying the highest proportional taxes in any community is the most profitable or desirable to its owners. It is also a pertinent question, why property which has paid taxes for a given period—say thirty years—and has so been absorbed by the public, should continue to be assessed; or why, if the person popularly regarded as the owner of such property should refuse to pay taxes, the property should be sold for taxes when it has already been taken to itself by the public.

Another point of interest in connection with this subject which has been little noticed by economists is, that if a high degree of civilization can not exist without a high degree of taxation,† the methods of economizing labor, or, what is the same thing, of producing a greater amount of product with a given amount of labor—conditions which make high civilization possible—enable a government progressive in this respect continually to take a larger share of the results of the work of its citizens, expressed in terms of money, without really increasing their burdens of taxation. "Every invention and discovery by which the production of commodities is facilitated and their value

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* This same fallacy was indeed applied to interest in the United States, when an eminent official maintained that in paying interest for many years on the public debt the people of the country had more than paid off the principal, and were therefore morally justified in repudiating the debt.

† Year by year the public demands more efficient schools, better postal facilities, better harbors, improved paving, drainage, and lighting of streets, a stricter abatement of nuisances and supervision of infectious disease. All this means a higher standard of public well-being, entailing, however, constantly increased public outlay.

reduced, enables individuals to spare a larger quantity for the use of the state. The sacrifice made in paying taxes, consists in the labor, or in the cost of the money or produce required to pay them and not in the amount of such money or produce." A given, amount of food and clothing, iron, steel, copper, leather goods, paper, and transportation can now, for example, be furnished to the Government of the United States for at least one third, and probably not more than one fifth, of the labor required to produce like quantities of these same commodities or services in 1840; while the wages paid for the work which such quantities represent or necessitate have been increased from fifty to seventy-five per cent and upward. In 1840 an operative in the cotton mills of Rhode Island, working thirteen to fourteen hours a day, turned off 9,600 yards of standard sheeting in a year; in 1886 the operative in the same mill made about 30,000 yards, working ten hours a day. In 1840 the wages were $176 a year; in 1886 the wages were $285 a year.

During the ten years from 1870 to 1880 the increase in the number of hands employed in anthracite coal mining was 32·2 per cent, as compared with an increase of product of 82·8 per cent; while in the case of copper during the same period the ratios were 15·8 and 70·8 per cent respectively. The whole tendency, therefore, of the modern conditions of production is not to entail any greater sacrifice on the part of the taxpayers for the support of the Government, but rather to diminish it. "Governments have precisely the same interest as their subjects in facilitating production, inasmuch as its increased facility affords the means of adding to the quantity of produce at their disposal without really adding to the weight of taxation; whereas, on the contrary, a diminished facility of production must either diminish in an equal degree the produce appropriated by government or compel it to lay heavier burdens on its subjects. Public wealth, in short, is merely a portion of private wealth transferred to government, and the greater the amount of the latter the greater, of course, will be the magnitude of the portion that may be conveniently spared for public purposes."—*J. R. McCulloch.*

WHEN TAXATION BECOMES AN EVIL.—It is not pretended that taxation, even under a correct system of assessment and collection, may not under some circumstances be an evil. It is an evil when through extraordinary or injudicious expenditures of the state it is excessive and demands too large a proportion of the annual or concurrent income of the people (in the form of rents, interest, profits, salaries, and wages), out of which, or out of the *annually* augmented wealth of a country, and not out of accumulated capital, all taxes ought to be paid, and as a rule are paid. The economic rule governing taxation of first importance

laid down by Prof. Cossa (*Scienza delle Finanze*) is "that it should, when possible, tax income only, whether national or individual, but spare the estate itself."

If the burden of taxation, or the amount taken, is not fully compensated by increased production or increased saving, it becomes one of the greatest evils to which a people can be subjected; for under such circumstances the means of future production will be impaired, encroached upon, and the country will necessarily begin to retrograde.

When the share of the annual product falling to the workmen of any country is barely sufficient to support life free of taxation, then the burden of taxes begins to promote pauperism. It takes that which is necessary to existence and the maintenance of energy. This is now occurring in Italy. The taxation of Italy probably absorbs more than one third part of the product of the country. The army is served first, the workmen second, while the women become diseased and the children die by lack of adequate nourishment.

Taxation is also an evil, though in a lesser degree, when the rate assessed is not the same upon all persons, property, and business within the same sphere of (business) competition; when it is made an instrumentality for effecting some other purpose than that of raising revenue, no matter how desirable that purpose may be; and when, as in the United States, it is largely indirect, and its incidence and amount are thereby concealed from the ultimate taxpayers.*

The general result of experience is also to the effect that when excessive and exceptional taxation has been resorted to by a state for the purpose of regulating or destroying industries or traffic, it has rarely been successful. The economic and moral lesson

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* A most interesting and instructive example of the decay in modern times of a considerable state due to radically vicious methods of collecting revenue is afforded by the present condition of the Asiatic kingdom of Persia. Its typical despotic government, represented by the Shah, annually demands and exacts a large amount of money from its subjects to defray the expenses of the state, but not more, perhaps, than the resources of the country and its people would fairly warrant and sustain, if it was collected by intelligent methods. In default, however, of any knowledge of how to get revenue without destroying the springs of wealth, the method of taxing is so irregular both as to time and rate, and so thoroughly unjust and unequal, as to impair the value and security of property, prevent accumulation and free use of capital, and discourage commerce. A British expert has recently reported to his home government that if a qualified European or American could be placed at the head of the exchequer at Teheran, who was allowed such control that no penny exacted from the people of the state should be absorbed on its way to the treasury, or be taken save in due course of law, he might yet save Persia and drain into it a new and vigorous Asiatic population, who would fill its now deserted but fertile plains, and organize a commerce in which all the world stood ready to participate and furnish the instrumentalities necessary for its development.

deducible from such experience may be briefly summarized as follows:

Whenever a government imposes a tax on any product of industry so high as to sufficiently indemnify and reward an illicit or illegal production of the same, then such product will be illicitly or illegally manufactured; and when that point is reached, the losses and penalties consequent upon detection and conviction—no matter how great may be the one or how severe the other—will be counted in by the offenders as a part of the necessary expenses of their business; and the business, if forcibly suppressed in one locality, will inevitably be renewed and continued in some other. It is therefore a matter of the first importance for every government, in framing laws for the assessment and collection of taxes, to endeavor to determine, not only for fiscal but also for moral purposes, when the maximum revenue point in the case of each tax is reached, and to recognize that in going beyond that point the government "overreaches" or cheats itself.

Increase the duties (taxes) on imports beyond a certain point, and smuggling springs up as by magic, and the most cruel and unusual punishments utterly fail to prevent it. American ingenuity was never more fertile or manifested in a more remarkable manner than in the evasion during the years 1864–'68 of a tax, approximating fifteen hundred per centum, imposed by the Federal Government on the manufacture and sale of distilled spirits, resulting in a complete failure on the part of the Government, with almost unlimited military resources at command, to enforce the law, and a final abandonment and repeal of the tax.* The comparatively recent tax imposed by the United States on oleomargarine, with a view of destroying its manufacture and preventing its use as an article of food, has been so far ineffectual that its production and consumption have been greater than they were before the law authorizing the tax was enacted.

More than a century ago Adam Smith pointed out that such taxes "tempt persons to violate the laws of their country, who are frequently incapable of violating those of natural justice, and who would have been in every respect excellent citizens had not those laws made that a crime which Nature never meant to be so."

Some other fallacies concerning the sphere and influence of

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* Out of a consumption of at least fifty million proof gallons of distilled spirits of domestic production in the United States during the fiscal year 1867–'68, the Federal Government collected a tax upon less than seven million gallons, the sale of the difference at the current market rates of the year, less the average cost of production, returning to the credit of corruption a sum approximating sixty million dollars.

taxation which have obtained popular credence may be here appropriately noticed.

Thus, it is not infrequently assumed that any injurious influences of excessive or unnecessary taxation are largely or wholly imaginary, inasmuch as they are really returned to the contributors (taxpayers) through the expenditures of Government; which, by increasing demand for commodities and services, create or extend markets, maintain prices, and enlarge the sphere or opportunity for industrial employment, and favor an increase in the supply and circulation of money. This assumption is obviously but a reproduction in another form of the fallacy (before noticed) that industry can be stimulated by taxation; and which in turn finds its antetype in a favorite idea of the middle ages that the destruction or waste of commodities "made good for trade"; and which maxim, it is said, a guild of glaziers in Paris practically carried out by encouraging their apprentices to break windows, who may have attempted to justify their conduct by asking themselves the question, "What would become of the glazing business if nobody ever broke windows?"

A general answer to this fallacy is, that to break, spoil, or *waste* by fire, pestilence, war, famine, shipwreck, or injudicious and unnecessary taxation and public expenditure, always entails a loss to society; and if these results give to certain class interests an opportunity to perform unnecessary work, or sell products at an advance over their current prices in the world's market, and thereby inflict unnecessary and additional taxes on other individuals, it can not be regarded as other than an evil, and prejudicial to public interests.

To those who live on the produce of *unnecessary* taxation and correlative governmental expenditure, any consequent encouragement of industry by increasing demand and extension of markets, will very naturally seem to be in the highest degree beneficial. But, in order that industry may be truly benefited, the market must be real and not artificial, or one created by unnecessary taxation and expenditure. "It is absurd to suppose that either individuals or states should receive the smallest benefit from the demand of those whom they have been previously and unnecessarily obliged to furnish with the means of buying. To keep up useless regiments and overgrown establishments on the pretense of encouraging industry is quite as irrational as if a shopkeeper were to attempt to increase his business and get rich by furnishing his customers with money to buy his goods."—*McCulloch.*

Hamilton (a Scotch economist) puts the case even more forcibly. "To argue," he says, "that the money raised in taxes, being spent among those who pay it, is therefore no loss to them, is no less

absurd than the defense of a housebreaker, who, being convicted of carrying off a merchant's money, should plead that he did him no injury, for the money would be returned to him in the purchase of the commodities in which he dealt."

"It is obvious that the services rendered by the various public functionaries who receive the proceeds of taxation form the only return made to the taxpayers. And it is undoubtedly true that these services are of the highest value, and that, when neither the number nor the salaries of those by whom they are rendered are unnecessarily large, they constitute a full and ample equivalent for the sums expended upon them. But all beyond this—all that is drawn from the people by means of taxes, to be expended in maintaining unnecessary functionaries, or in overpaying them—is wholly lost to the taxpayers, or is not in any way compensated to them."—*McCulloch.*

"We might as well say that it would be a good thing to put snags in the rivers, to fell trees across the roads, to dull all our tools, as to say that unnecessary taxation could work a blessing."—*Prof. W. G. Sumner.*

Some writers of repute have advocated the special imposition of taxes on the ground that they act as stimulants to industry. M. Garnier entertained this opinion. The late J. R. McCulloch, who wrote learnedly on the Principles of Taxation, favored such practice on the part of government, provided the taxation was "*moderate.*" But of taxation employed for such object which was not moderate he wrote as follows:

"The effect of exorbitant taxes is not to stimulate industry, but to destroy it. The stimulus given by excessive taxation to industry has been not inaptly compared to the stimulus given by the lash to the slave—a stimulus which the experience of all ages and nations has proved to be as ineffectual as it is inhuman, when compared to that which the expectation of improving his condition gives to the productive energies of the citizen of the free state."

The direct beneficial agency, not merely of moderate but of most excessive taxation, as a stimulant to industry, is also obviously a fundamental principle in every so-called "protective tariff system."

Very curiously, the best refutation of these ideas was made by the late H. C. Carey, in a Treatise on Wealth, published in 1838. After indorsing the statement of Mr. McCulloch as to the influence of exorbitant taxation on industry, and the correctness of his analogy between the stimulus afforded thereby and that imparted by the lash, he antagonizes the proposition that the effect of even *moderate* taxation imposed as a stimulus to industry can be in any degree beneficial, by asserting that what is true of the influence

of exorbitant taxation in this respect "is equally true of all unnecessary burdens (of taxation), whether great or small."

"If taxation be a stimulus," he says, "the advantage must increase with its extent, and taking 2*s.* per week must do more good than taking 1*s.* Moderation depends upon habit. We think Mr. McCulloch has fallen into the same error with the man who attributes increased vigor to two glasses of brandy, while he deprecates the drinking of a quart as likely to produce intoxication. The man in sound health who drinks two glasses will not work as well as he who drinks none, but he will do so much better than his neighbors who drink by the quart that it may be supposed that his superiority results from the glasses taken, when it really arises out of the six that he has forborne to take. If taxation be good, so is the lash: both will make people work, but neither will make them work well. The moment we admit that taxation in any case tends to promote industry, it is impossible to say where we shall stop."

Another fallacy which has obtained credence, especially in recent years in the United States and even among its legislators, is that the burden of taxation is increased by a fall in the prices of commodities which represent the work that furnishes the money with which taxes are paid. It owes its existence and tolerance to the non-recognition of a principle of taxation which has also been thus set forth by Mr. J. R. McCulloch:

"The amount of a tax is not to be estimated by the *bulk* or *species* of the produce which it transfers from individuals to government or to creditors in general, *but exclusively by its value.* A heavy tax consists in the abstraction of a large value, and a light taxation in the abstraction of a small value. When a fall takes place in the cost of producing any article, its price necessarily declines in an equal degree, and its producers are obliged to dispose of a proportionally larger quantity to obtain the means of obtaining the same amount of taxes. But it is an obvious error to suppose, as is very commonly done, that the burden of taxation is consequently increased. The value paid by contributors remains the same, and it is by values and not by quantities that the weight of taxation is to be measured. If through improvements in agriculture, machinery, or any other cause, two quarters of wheat or two yards of cloth were produced with the same expenditure of capital and labor that is now required to produce one quarter or one yard, it would be no hardship to give double the quantity of wheat or cloth in payment of taxes."

A failure to recognize and understand this principle has led to much erroneous reasoning on the subject of taxation, and finds a curious practical illustration in the following record of recent experience. Thus in the so-called bimetallic discussion in the

United States it has been unqualifiedly asserted that, owing to the remarkable decline in the average prices of general commodities (estimated at about eighteen per cent from 1867 to 1877, and thirty-one per cent from 1867–'77 to 1886–'88), and which in turn has been assumed to have been occasioned by the demonetization of silver and consequent appreciation in the value or purchasing power of gold, the burden of the national debt of the United States and also all private debts, especially such as are in the nature of mortgages on land or on other productive fixed capital, has been greatly increased, inasmuch as a greater effort of labor or an increased amount of the products of labor—typically cotton and iron—had become necessary to liquidate such debts and the interest thereon.* The error in such reasoning or assumption is found in the circumstance that no consideration is given or allowance made for the different results of labor at the periods of price comparisons, and that the *real* cost of producing the staple commodities of the United States, or the effort needed to produce a given amount of general merchandise, or the number of days' work put into each piece of such merchandise, has on an average decreased during these periods more than their market prices have decreased, so that instead of the decline in the prices of commodities under consideration having increased the burden upon labor of national and other debts created before such decline, the burden has been lessened to just the extent that the average cost of producing commodities has declined to a greater degree than their average market prices. Thus all authorities are substantially agreed that there are few departments of industrial effort in which the saving of time and work in the twenty to thirty years next anterior to 1890 was at least forty per cent, and in not a few instances has been much greater (in the manufacture of boots and shoes, for example, eighty per cent). In North Carolina the relative increase in cotton product and population from 1870 to 1880 was as 4·5 to 1. With slight changes in the relation of labor to product, the cotton crop of the United States increased seventy-six per cent between the years 1866 and 1872, and forty-nine per cent between 1872 and 1886. Recent investigations have shown, in the case of certain leading articles in hardware, that a given quantity which represented a labor cost in

* In 1885 a memorial signed by ninety-five members of the United States House of Representatives of the Forty-eighth Congress and presented to the President of the United States contained the following statement: "Eighteen million bales of cotton were the equivalent in value of the entire interest-bearing national debt in 1865 ($2,221,000,000); but it will take thirty-five million bales at the price of cotton now (1885) to pay the remainder of such debt ($1,196,000,000). Twenty-five million tons of bar iron would have paid the whole debt ($2,674,000,000) in 1865; it will now take thirty-five million tons to pay what remains ($1,375,000,000) after all that has been paid."

1870 of a million dollars could be afforded in 1894 for a like cost of $444,444. Another striking illustration of the present cheapness of manufactured articles per unit and as measured in terms of labor payments per hour or day, compared with former recent periods, and as the result of present industrial conditions, is found in the statement that wire nails are now so cheap that, if a carpenter drops a nail, it is cheaper to let it lie than take time to pick it up; and the correctness of which has been demonstrated as follows: "Assuming that it takes a carpenter ten seconds to pick up a nail which he has dropped, and that his time is worth thirty cents per hour, the recovery of the dropped nail would cost 0·083 cent. There are two hundred sixpenny nails in a pound, and they are worth on an average 1·55 cent per pound, making the value of one nail 0·0077 cent. In other words, it would not pay to pick up ten nails at the assumed loss of time and rate of pay of the carpenter."

On the other hand, wages have increased in the United States since 1870 in an approximative ratio with the increase in the effectiveness of labor in producing commodities, and touched the highest point ever known about the year 1890. During the same period debtors have gained greatly by the decrease in the cost of living, and a consequently increased opportunity for laying up a surplus for meeting tax demands and other purposes. The assumption that the comparatively recent fall in the price of commodities in the United States has increased the burden of taxation upon its people, therefore merits the characterization of being one of the most irrational and fictitious of popular economic fallacies.

SOME interesting facts concerning the Hausas and their country in Africa were communicated to a recent meeting of the Royal Geographical Society by Mr. J. A. Robinson and Mr. William Wallace. Mr. Robinson has paid much attention to the language and literature of the people. Nearly all of them have learned to write in the Mohammedan schools, and business is largely done by correspondence. An association has been formed to promote the study of the language; and a college is talked of to be established at Tripoli. Mr. Robinson has brought back specimens of native literature, of which a volume is to be published. Crops of many kinds are raised, of which Mr. Wallace names fourteen specifically, with others; and large stocks of horses are kept. At Farra, the chief seat of the iron trade, Mr. Wallace visited the smelting furnaces, but was not allowed to see the mines from which the iron ore is dug. At Jaga he found an important commercial town, with large pottery works and dye works, and industries in iron and leather. A part of the country, which was once very prosperous, is, however, now a retreat for robbers, who keep the neighboring region in terror. Mr. Wallace affirmed that peace and freedom only are needed to convert Hausaland into another India.

THE SYMPSYCHOGRAPH: A STUDY IN IMPRESSIONIST PHYSICS.

By DAVID STARR JORDAN.

THE Astral Camera Club of Alcalde was organized in November, 1895, for purposes of scientific research through the medium of photography. The function of the club was the co-operative study of man's latent psychical powers, that these might be made helpful in the conduct of life. No powers granted to man should be neglected or allowed to waste in idleness. Just as the great physical force of electricity remained for centuries hidden, and known only by casual and unimportant manifestations, so the great odic forces within man still are scantily revealed. The method of the club in Alcalde was to be that of the most rigid scientific research. It was to take up, one after another, the discoveries of our eager century as they were made known to the world through the medium of the daily newspaper. To these were to be added those suggestions which alert intuition and psychic practicality would naturally suggest. No hypothesis in science was to be rejected beforehand, and no prejudice was to stand in the way of the reception of any new theory that might contain a living truth.

As soon as the news of the marvelous experiments of Prof. Röntgen had reached Alcalde, the Camera Club began work on the X rays, and on the larger problem of the significance of photography without visible light. They had no difficulty in repeating the usual experiments. They got an outline of the skeleton of a canary, the shadow of an empty pocketbook, the bones of a finger surrounded by a gold ring, and the location of an imbedded shot. Thus those strange rays of light, or odic force, invisible to our eyes, because none of our ancestors ever had a chance to gaze upon them, disclosed the presence of objects which had else lain forever in darkness. In addition to this, the green light of the vacuum tubes provoked that uncanny feeling which always precedes and presages a great discovery in occult science. From this feeling the club was safe in predicting that far greater discoveries were to follow, and that the X rays would not end in mere repetitions of Röntgen's triumphs in "skiography."

In this they were not disappointed. Prof. Inglis Rogers, of London, found that not only could pictures be produced in darkness by means of invisible force, but that the invisible waves sent out through the ether by the mind could also affect a sensitive plate. Just as one sensitive mind at a distance receives an image sent out from the psychic retina of another, so could the same image be concentrated and fixed upon a photographic plate. Prof.

Rogers in a matter-of-fact way looked for a few minutes at a postage stamp, then retired to a dark room, and gazed through the lens of the camera at the sensitive plate. The figure of the postage stamp was on his mind, and from his mind it passed out through the sensitive ether to the plate made ready to receive it. The result was a photograph of the stamp—small and a little blurred, but showing the undoubted features of the gracious Queen and the words "one penny." Thus was the bridge between psychic power and photographic sensitiveness made once for all. This connection established, there is naturally no limit to the application of the principle.

It thus becomes plain that the invisible rays of Röntgen are not light in the common sense, but akin rather to the brain emanations, or odic forces, which pass from mind to mind without the intervention of forms of gross matter as a medium, and to which gross matter in all its forms is subject.

Nor is this principle new in the philosophy of man. The wise of all ages have held that mind is sovereign over matter. Besides this general law, it has been known to our fathers that in the eye of the dying man is impressed the last scene on which he looked in life. With instruments of precision we may examine that scene, and by skillful photography we should be able to secure and fix it for all time. Whittier foreshadows the broad law on which this rests when he asks:

> Do pictures of all the ages live
> On Nature's infinite negative,
> Whence half in sport, in malice half,
> She throws at times, with shudder or laugh,
> Phantom and shadow in photograph?

It may be that by means of such negatives History is able to repeat herself. It is not unlikely that among the latent powers which are conferred upon man by the possession of the astral body, are those which will enable him to read the pictures on the infinite negatives of Nature, and by that means to rescue the records of the vanished past.

Following the experiments of Prof. Rogers, other physicists have tried to photograph the psychical images as they are impressed on the retina by the force of imagination. It is evident that such images are distinct from those arising from immediate contact with reality; but their real nature is the same in essence. When Inglis Rogers was gazing at the stamp he saw only an image on the retina, and in reality it was not on the material cells of the retina itself that the image rested, but it was on the *tabula rasa* of the mind. It was outward from the mind itself, not from the retina, that this was projected through the sensitive and responsive ether to the sensitive plate of photography, an arrange-

ment of unstable cells which is the triumph of the art of the chemist.

It is therefore not necessary for this experiment that one should gaze at an individual stamp. To think of a stamp will serve as well. Recognizing this fact, Mr. Cameron Lee, another English experimenter, attempted to secure the image of a thought. Placing his own eye in the focus of a lens in absolute darkness, he thought intensely of the face of a certain cat. After a long exposure, necessary on account of the comparative grossness of the photographic materials, a picture was formed. The negative shows a rounded outline evidently that of the enlarged pupil of the eye, and in its center was formed a faint image, which could be mistaken for nothing other than a cat. An account of this experiment was given in the daily press, but its true bearing was first seen at Alcalde.

At the meeting of the Astral Camera Club held in Alcalde on April 1st of this current year, its president, Mr. Asa Marvin, read a paper on these discoveries, calling attention to their astral significance. The supremacy of mind over matter, already indicated in a hundred ways, was thus splendidly illustrated. As a thousand miles of ether may be made to vibrate at the command of the will of the psychical adept, so may the grosser forms of matter be shaken or removed when this subtle and resistless force acts upon it.

The famous legend of Odin and the Golden Mead, as Mr. Marvin went on to show, is not a myth, but was probably an actual occurrence. It may be a reality again when Odin's descendants rival their ancestor in that wisdom for which the famous hero so freely gave his right eye. It is not unlikely that the actual Niffelheim, or mist-home, where he exchanged his right eye for wisdom, is to be sought in the Himalayas rather than in Scandinavia. Odin, it will be remembered, after he had gained this wisdom, wished a draught of the golden mead which the giant Suttung kept locked up in his strong house of stone near his castle of Spukheim. Odin had arranged with the giant Bauge, whose hay he had harvested, that he should help him to secure this life-giving drink. And thus, the saga tells us, when they had found the stone castle in which the mead was hidden, Odin and Bauge sat down all day before the stone wall and gazed steadily upon it. By this means, so the story goes, they bored a small hole through the stone large enough for Odin in the astral form of an angleworm to pass through, and by this means the mead was gained and the strength of the giants passed over to mortals.

The essence of this story lies in its illustration of the power of mind over matter when its forces are concentrated. By psychic intensity the cohesion of molecules of gross matter may be over-

come. It is well known to physicists that these molecules nowhere actually touch each other, nor do they come near doing so. The spaces between them are filled up by ether. Into the interstices of the ether it is easy for the odic force to introduce itself. It is, in fact, unlikely that the gross particles of stone exist at all; for, as some physicists have shown, these are but eddies or vortex-rings in the ether itself, which is the only material reality.

Mr. Marvin showed very clearly that this supposed legend was not lightly to be set aside as mythology; or, rather, that it is likely that mythology is the only true history. The same psychic strength and wisdom which have caused Odin to be remembered and revered as a god by our ancestors, was the same psychic force by which he overcame the cohesion of matter. For us all to do this is doubtless only a question of time. Many adepts are already able to do more wonderful things than these. In time the evolution of man will bring these latent powers to light, superseding our common reason with astral intuition as reason has supplanted mere animal instinct.

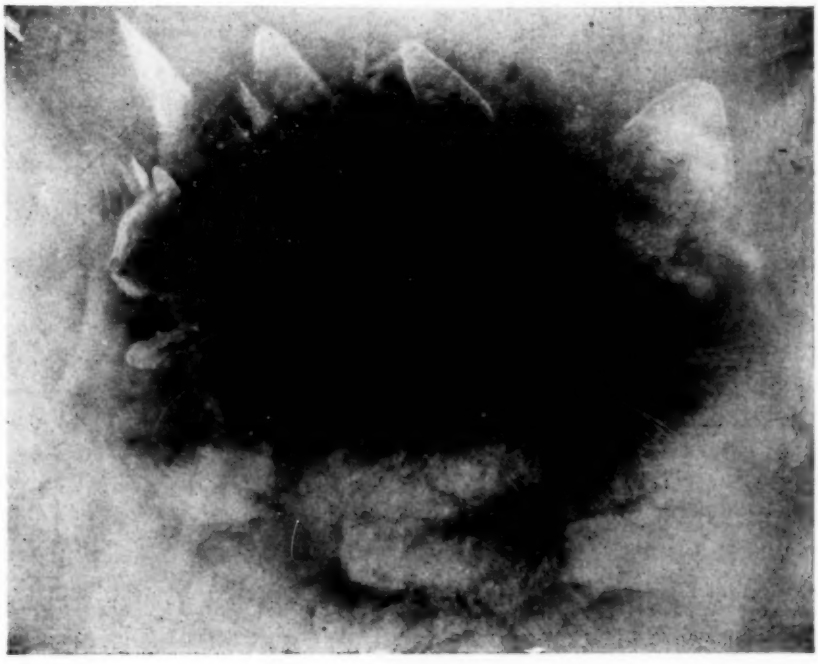
Having thus shown the broad principles on which studies in the new psycho-physics must rest, Mr. Marvin described a special contrivance or application of these principles to the work of the Camera Club.

He had devised a camera with a lens having curved facets arranged on the plan of the eye of the fly. To each one of the seven facets led an insulated tube provided within by an electric connection, so that electric or odic impulses could be transferred from the brain or retina through the eye of each different observer to the many-faced lens. From the lens these impulses would be converged on a sensitive plate, as the rays of light are gathered together in ordinary photography.

From the members of the Camera Club, seven of those having greatest animal magnetism and greatest power of mental concentration were chosen for the experiment. Connection was made from the eye of these observers to the corresponding parts of the lens; then all were to remain in utter darkness and perfect silence, each person fixing his mind on a cat. They were not to think of any particular cat, but of a cat as represented by the innate idea of the mind or ego itself. This was highly important, for the purpose of Mr. Marvin was not simply to fix by photography an ephemeral recollection, as Mr. Rogers and Mr. Lee had done; it was to bring out the impression of ultimate feline reality. The innate image in the mind was the object desired. One man's thought of a cat would be individual, ephemeral, a recollection of some cat which he had some time seen, and which by the mind's eye would be seen again. From seven ideals, sympathetically combined, the true cat would be developed. This combina-

tion is the essence of *sympsychography*, a term suggested by Prof. Amos Gridley, of Alcalde, as distinct from the ordinary ideography of Rogers and Lee. The personal equation would be measurably eliminated in sympsychography, while the cat of the human innate idea, the astral cat, the cat which "never was on sea or land," but in accordance with which all cats have been brought into incarnation, would be more or less perfectly disclosed.

In accordance with this plan the experiment was tried under the direction of Mr. Asa Martin. By the courtesy of the secretary of the club, Miss Corintha Jones, of Alcalde, we are enabled



to present a copy of the resultant sympsychograph in advance of the publication of the regular bulletin of the society in which the apparatus used is figured in detail (see Plate 10).

It will be noticed that this picture is unmistakably one of a cat. But it is a cat in its real essence, the type cat as distinguished from human impressions of individual cats. This achievement, like the earlier ones of Odin, Röntgen, Rogers, and Lee, opens great vistas for future scientific research. The next experiment will be by similar means to photograph the cat's idea of man.

As might be expected in a first attempt, there is a lack of coordination of the parts. Mr. Gridley, the schoolmaster, had

planned his cat on a large scale, a huge cat face with gray radiant whiskers looking directly at the beholder. Most of the others thought of the cat in lateral view or profile. These variant and vagrant individual impressions naturally appeared on the camera before the ether waves were co-ordinated and the reflex influences came back from all to one, regulating and co-ordinating the thought of the cat. Thus these preliminary impressions are recorded as ghost pictures in various places about the plate before the ultimate composite view was achieved. The delay in this regard has darkened the center picture, interfering a little with its perfection of definition. This darkening would probably appear in other experiments on account of the long exposure (sixteen minutes) thought necessary for a picture of this kind, in which odic magnetism is made to take the place of light.

On the cat's cheek is a curious black spot or stigma which has not been fully accounted for. From its sharpness of definition it must stand in some relation to each of the seven persons whose thoughts were centered upon it. One suggestion was that this was the blind spot on the retina in each of the sympsychographers. But the blind spot marks the point of entrance of the nerve which goes back to the brain. While it may not have visual power, it is not unlikely that it is a point of special activity in ideography. This suggests that the black stigma may be the yellow spot, or the *macula lutea*, the point of acute vision, a region on the retina where odic forces would naturally be absent. Mr. Marvin himself inclines to the opinion that a microscopic examination of the negative will show that this stigma has likewise the form of a cat, and that it will be found to be an ideomorphic germ or centrum where the co-ordinate thought of the cat has first impinged on the plate and from which the image of the cat has concentrically arisen.

Meanwhile the cat of Mr. Thompson, the janitor, who alone could answer this question, lay in the darkness under the warm stove and purred softly.

ENUMERATING the uses made of the fan in Japan, Mrs. C. M. Salney says that the seven gifts of a Japanese bride to her spouse invariably include a fan—in fact, fans are the most frequent gifts in Japan, and are used to present gifts upon. They are much employed for juggling; singers modulate their voices with fans; they have served as news sheets—sometimes as seditious news sheets—and as vehicles of satire. Maps for travelers are printed on fans. Ceremonial fans are employed when houses and other buildings are finished. The fans made for the Japanese themselves are usually not the same as those intended for the Western market. The Japanese prefer smaller fans, quieter in tone and color, and more refined than those that Europeans like.

SOME MODERN VIEWS OF THE CELL.

By JAMES ELLIS HUMPHREY.

HARDLY more than a generation ago naturalists were forming, under the lead of the great Englishman, those conceptions of organic development and of the blood relationship of living beings resulting from common descent which have formed the starting point of almost all subsequent research. During the same years in which Mr. Darwin was accumulating the facts which were to form the imperishable foundations of his superstructure, various German investigators were gradually recording the observations that have afforded equally secure grounds for that view of the essential substance of living organisms which found expression at about the same time with the development theory, and which has exercised a hardly less profound influence upon biological investigation—the *protoplasm* theory.

But the beginnings of our knowledge of the intimate structure of plants and animals reach back two centuries further to the work of an English physicist and optician, Robert Hooke. This man, desiring to demonstrate his improvements in the manufacture of magnifying glasses, published in a volume entitled Micrographia, or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses, in 1667, accounts of the appearance of various objects when viewed with his lenses. Among the objects upon which he had chanced was a piece of cork, and this he found to consist of a series of empty cavities separated by thin partitions, to which cavities he gave the name of *cells*, from their suggestion of the cells of a honeycomb. But although we now know that cork is a dead issue which no longer contains any essential component of the living cells, and although our conception of a cell is to-day quite opposed to that of a tightly closed chamber, such as the name implies, yet Hooke's name, given so long ago to the dead shell, is still retained for the living reality. And here we have one more example of the operation of that interesting conservatism of the human mind which perpetuates established terms or customs or beliefs long after their original fitness and *raison d'être* have been outgrown.

Hooke's work was only one phase of the extraordinary scientific activity that characterized his time. The first fruit of the splendid awakening of the human mind from the paralysis of scholasticism which we owe to the Baconian philosophy was a zeal for the study of Nature; and from this period date some of the most brilliant discoveries in natural science. It is a notable coincidence that in the year 1671 there were presented to the lately established, but already famous, Royal Society of London

two elaborate treatises on the minute structure of plants, which had been quite independently worked out, the one by Grew, an Englishman, the other by Malpighi, an Italian. But their admirable work remained for more than a hundred years the standard of knowledge in plant anatomy, while the overwhelming authority and example of the Linnæan school reduced botany to the superficial examination of dried fragments, and comprised all needed knowledge of a plant in the determination of its Latin name.

For the beginnings of our real knowledge of the cell we must, then, leap the chasm of a century and a half to come again upon a period of improvement of the microscope as affording the means for further advance. In this case the important discoveries of Amici, resulting in lens systems in which both chromatic and spherical aberration were largely corrected, offered to histologists far better tools than had hitherto been at their command. Grew and Malpighi had distinguished in plants two kinds of elements, approximately isodiametric *cells* and much elongated *vessels;* but Treviranus had shown, early in the present century, that vessels are derived from rows of cells by the obliteration of intervening walls. And about the same time he had rediscovered the now familiar circulation in the gigantic cells of the brittleworts, or *Characeæ*, which, first described in 1772 by Corti, had been forgotten in the zeal for taxonomy which possessed his contemporaries. But gradually the idea grew that the contents within the walls of the cell are of importance; that the real cell is a living thing which nourishes itself and grows. One of the earliest clear expressions of this idea was written by Meyen in 1830, who spoke of cells of higher plants as "little plantlets in the greater." But the general spread of such views and general interest in cell problems date from the time when Schleiden's clear mind was turned upon them. Going directly to the heart of the whole matter as it then stood, he asked, "How do cells arise?" and set himself to answer the question. As a probable clew to its solution he seized, by a happy inspiration, upon the discovery made a few years before by Robert Brown that the cells of certain plants studied by him contained each a rounded, rather highly refractive body, which he had called, and which is still called, the *nucleus*. Demonstrating, with the aid of others, the very general occurrence of this structure in plant cells, Schleiden made it the center of his theories of cell life and cell formation. It is true that his belief that new nuclei are formed by a sort of crystallization out of a mother-liquor and then form centers for the formation of new cells, has been proved to be incorrect. And it is equally true that his idea of the cell as a closed chamber filled with fluid, whose wall is its most essential part, is no longer entertained.

Yet the fact that his theories turned attention to the cell contents also, and the fact that the most conspicuous object in almost any animal cell is its nucleus, made these most fruitful in their results, as other mistaken theories have often been. The analogy between plant and animal cells, suggested by the presence of nuclei in both, led Schwann to thorough and profound investigations of animal tissues, in which he happily recognized the fundamental importance of the study of the development of a tissue for the elucidation of its nature. In this way he showed that animal tissues are made up of elementary units comparable with the cells of plants. The final recognition by Schleiden and Schwann, at the end of the fourth decade of the century, that all organisms consist wholly of cells and the products of their activity laid the solid foundations of the cell theory and brought animals and plants into new and most suggestive relations.

Studies of the nucleus had necessarily drawn attention to the granular substance which surrounds it and more or less completely fills the cavity of the cell, and it had already been called "plant mucus" by Schleiden. In 1844 Naegeli determined it to be a nitrogenous substance, and, together with von Mohl, recognized its presence in all living plant cells, while the latter botanist, two years later, first called it *protoplasm*, or primitive substance. Up to this time the leading naturalists believed in impassable barriers and inherent differences between plants and animals. One of these supposed distinctions was the rigid and immotile character of plants as compared with the motile and contractile power of animals. The special contractile substance of animals, which was recognized as homogeneous or finely granular and albuminous, had already been called "sarcode" by Dujardin. But when, in 1850, Cohn showed that some plant cells possess no membrane and that their protoplasm shows the contractility and other supposedly characteristic properties of sarcode, he felt justified in saying with much certainty that "the protoplasm of the botanists and the contractile substance of the zoölogists, if not identical, must yet be structures in a high degree analogous." But this conclusion, expressed incidentally in a paper on another subject, did not receive the attention it deserved. It was not until thirteen years later, when the way had been prepared by the work of De Bary on the Slime Molds and of Haeckel on the Radiolarians, that biologists were convinced by Max Schulze's masterly discussion of the subject of the identity of the substances in question. With the new view of the identity of all living substance went a radical change in the conception of the cell. The cell membrane, which is rarely present in animals, was relegated to the list of unessential constituents, and the vital center was transferred in mind to the cell contents, where it has

been, in fact, since the beginning. The kernel of the new protoplasm theory, which, as before stated, has since dominated research, is contained in Schulze's definition of a cell as "a lump of protoplasm endowed with the properties of life." Yet for a few years some botanists found it difficult to give up the old idea of the active participation of the cell wall in the life of the cell, until Sachs's classic studies removed the last basis for such belief.

We have seen that Schleiden and Schwann recognized that it is only cells and their products which make up the substance of all organisms, but that their ideas of how cells arise were quite erroneous. It was soon observed by von Mohl and Naegeli that cells multiply by the division of those already present, and botanists soon came to the conclusion that plant cells can only come from previously existing ones. This conclusion was reached much more slowly for animals, since it presented many difficulties in the field of pathology, especially in connection with such processes as the formation of pus. But gradually the objections were shown to be of no weight, and the great pathologist Virchow, in 1858, gave expression to the result in the aphorism, "*Omnis cellula e cellula.*"

It will be noticed that the view of the cell current thirty years ago laid less stress upon the nucleus than that of twenty-five years earlier; and we shall see that more importance is attached to it to-day than ever before. Yet, so far as it went, Schulze's view of the nucleus was better than Schleiden's, for it recognized it as a specially differentiated organ of the protoplasm, though knowledge of its particular relations to the activity of the cell was very meager. Up to about 1875 it was generally thought by zoölogists that, before the cell divides, the nucleus is constricted into two portions, one of which forms the nucleus of each of the new cells. The botanists, on the contrary, generally believed that the nucleus disappears before cell division, after which a new one appears in each new cell. These conclusions had been reached by studies of living dividing cells. Practically nothing had been done with preserved material, since no one trusted results so obtained or believed it possible to guard against artificial appearances due to the action of the preservative medium. The introduction of alcohol by Strasburger for killing and preserving tissues, and the proof by comparison with fresh material that no destructive or misleading changes are produced by it, mark the beginning of the epoch of cell studies, which has been characterized by a most astounding development of technical methods for killing, preserving, staining, and sectioning tissues of every sort with the least possible alteration in their living structure. The results of the first profound studies of the nucleus are contained in two volumes which laid the foundations for all future

cell work—that of Strasburger on plant cells, which appeared in three editions from 1875 to 1880, and that of Flemming on animal cells, published in 1882. These authors showed that in both plants and animals cell division is ordinarily preceded by nuclear division. This latter process is not usually a mere constriction, but is, as we shall see, a highly remarkable and significant one, with a wonderful agreement in detail throughout both animal and vegetable kingdoms, so far as studied. The literature of the past fifteen years concerning this subject is of almost incredible volume, but it has all served to confirm the prime importance of the nucleus as an organ of the cell, and to show the correctness of Flemming's extension to the nucleus of the principle long before established for the cell, in writing "*Omnis nucleus e nucleo.*"

While we attribute to the main mass of the protoplasm outside of the nucleus less specialization than to the latter, there appears to be a certain portion of it which has a special rôle. As early as 1883 the Belgian zoölogist, Van Beneden observed that certain tiny protoplasmic masses bear a definite relation to nuclear division, and he expressed his belief that these should be regarded as definite organs of the cell. This view has steadily gained ground, and, although they were not recognized in plant cells until 1891, when Guignard discovered them, on account of their minute size and of the technical difficulties connected with making them visible, their general occurrence and importance may now be said to be well established. These tiniest of the known organs of the cell are called *centrospheres*. Each consists of a central point surrounded by a mass of apparently homogeneous hyaline protoplasm.

Having now traced the development of our ideas, we are prepared to express our present conception of a typical cell as a mass of living protoplasm within which are differentiated a nucleus and one or two centrospheres. Many plants and animals consist of single cells, while others are built up of millions of these units of structure; but any organism is either an independent cell or an aggregation of cells more or less mutually interdependent. Some of the simplest unicellular organisms, like the *Bacteria*, of whose work in the world we now hear so much, are so minute that no differentiation within the cell has been observed. But rapid improvement in methods of study and means for observation are steadily reducing the number of these. Let us try, then, to get an idea of the best-established facts and views concerning the activities of the cell, and as to the part played by each of its organs in these activities.

Most plant cells are inclosed, as we have seen, in a firm wall, usually composed of a substance known as cellulose. Animal cells are, as a rule, without a definite membrane, and it is not cer-

tain that, in any case where a wall does exist, it consists of true cellulose.

The protoplasm of a cell is usually bounded at its outside by a denser hyaline layer which is very impermeable for fluids while living, and thus serves as a protection against the penetration of foreign or harmful substances into the cell. But this outer layer appears also to be the receptive portion of the protoplasm which is sensitive to and transmits external stimuli. Within it is the rather fluid, undifferentiated, granular protoplasm which constitutes the basis of the cell, and in which lie the special organs of which we have spoken. This wonderful mixture of albuminoid or proteid substances, which has well been called "the physical basis of life," must therefore possess those fundamental properties of living things, the power to assimilate, to grow, and to respond to external stimuli; and it is easy to show that living protoplasm possesses all these properties. But the one which most interests us just here is that of *assimilation*. This power of converting food into its own substance, which may result in the increase of that substance, or growth, seems specially to belong to the granular protoplasm, which may be regarded as the nutritive organ of the cell. Just here we note that the food which may thus be assimilated must be organic substance. It may be proteid, like albumin, casein, or fibrin; it may be a carbohydrate, like sugar or starch; it may be a hydrocarbon, such as fat or oil; but organic it must be. Whence comes now the supply of food? Plainly, in most cases, by absorption from without. In animals the solids and fluids taken in are reduced by digestion to the fluid form, and are then transported to the various cells of the organism, to be absorbed and assimilated by them. In those plants known as *fungi*, which can develop only on living or dead organisms, the food materials are absorbed in fluid form, being sometimes first reduced to that form by the action of a ferment secreted by the fungus. But certain cells of most plants have the power of manufacturing their own food from inorganic materials, and thus of living independently of other living things. Thus the green plants bridge over the chasm between the inorganic and the organic, and the life of all organized beings is practically contingent on their life. In the granular protoplasm of some cells of these plants may be found differentiated protoplasmic masses which contain the green pigment *chlorophyll*, that gives them their color. First recognized early in the present century, these masses were observed by Naegeli, in 1846, to increase by division, and therefore to constitute living organs of the cells in which they occur. These chlorophyll bodies possess the synthetic power of recombining the elements of simple compounds obtained from the air and the soil, in the presence of light, into complex organic

compounds which can serve the organism as food. Thus plant cells which contain chlorophyll bodies differ from all other cells in manufacturing their own food and in not being obliged to obtain it from without. Since in all or nearly all plants the lack of chlorophyll, when it is lacking, is due to degeneration in consequence of the acquirement of a saprophytic or parasitic mode of life, the possession of chlorophyll bodies and the consequent food-forming power constitute the most real distinction which separates plants from animals. Treated understandingly, this affords the most satisfying response to the ever-recurring demand for a statement of the differences between the two organic kingdoms, although the distinction is no more an absolute one, as shown by the case of the *fungi*, than any of the other less important ones often suggested.

We have seen that most plant cells possess firm walls, and it is little more than a decade since plants were generally believed to consist of blocks of protoplasm quite shut off from each other, in most cases, by the surrounding walls. The many difficulties entailed by such belief, and the impossibility of explaining the transfer of substance or the transmission of stimuli in certain tissues, was the chief incentive to Gardiner's researches. This author and others after him have shown that, in most tissues, and especially just where they are needed to explain observed phenomena, tiny threads of protoplasm penetrate the cell walls, connecting the protoplasmic masses of neighboring cells and forming the means of communication between them. So that we no longer think of the cells of a multicellular plant as isolated masses of protoplasm, but as connected masses, while the intervening walls give the necessary rigidity and resistance to the tissue.

Passing now to the *nucleus* of the cell, we find a complicated structure. Surrounded by undifferentiated protoplasm, it is bounded against it by a very delicate "nuclear membrane." Within this is a loose network of somewhat solid substance, whose meshes are believed to be filled by a clear, structureless fluid. In this lie one or more small globular masses of a very strongly refractive substance, known as *nucleoli*. That the nucleus is the controlling organ in the more active cell processes is indicated by many facts. It has been found that a cell from which the nucleus has been removed is unable to grow or to form new cell wall. In cells in which growth or any active process is taking place at some definite point, the nucleus takes a position near to that point, although thus lying far from the center of the cell. Any shifting of the point of greatest activity is accompanied by a corresponding change in the position of the nucleus. The centrospheres lie ordinarily close beside the nucleus and play their chief rôle in connection with its division, which we may proceed to discuss.

We have already seen how the conclusion was reached that cells can arise only from pre-existing cells, and that this occurs usually by division. Under favorable circumstances, when a growing cell has reached a certain rather indefinite limit of size, it proceeds to divide into two cells. But each of the new cells must have a nucleus and centrosphere; and we know that these can only arise from already existing ones, and by division. The process of nuclear division, as before remarked, is usually a very elaborate one, commonly known to students of the cell by the name *karyokinesis*. Indeed, so fundamentally important does this process appear, that the simpler method sometimes observed is believed by many biologists to have a pathological significance. The first sign of approaching karyokinetic division in a nucleus is the thickening of the threads of the nuclear network. This thickening continues, and at the same time the power of the threads to take up certain staining substances, now much used in their study, rapidly increases. Gradually the network resolves itself into a loose skein or coil, and at last this breaks up into a number, varying much in different species, but pretty constant in the same one, of separate rods or loops. These individualized portions of the original nuclear network have received the name of *chromosomes*, from their marked capacity for staining. Meanwhile the centrosphere, if previously single, has divided, and one of the pair has moved to each of the poles of the nucleus. At least in the higher plants, this division has occurred long before.

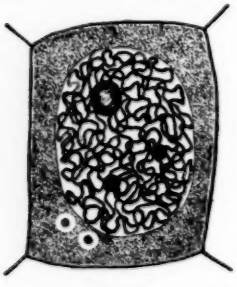


Fig. 1.

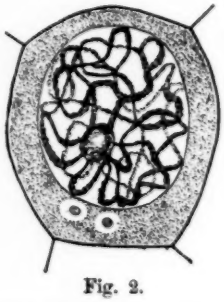


Fig. 2.

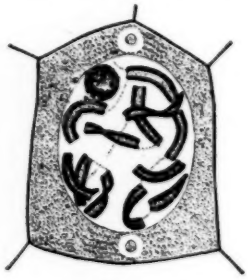


Fig. 3.

FIG. 1.—A plant cell, with its nucleus showing the chromatic network and nucleoli, and with a pair of centrospheres.
FIG. 2.—A plant cell whose nucleus is preparing for division.
FIG. 3.—A plant cell in an early stage of division, its twelve chromosomes separated.

The nuclear membrane now disappears and there is formed, perhaps from the homogeneous protoplasm of the centrospheres, or from the substance of the nucleoli, or from both, a spindle-shaped framework of delicate fibers, about whose equator the chromosomes become arranged in a circle. Then is completed a process which may have begun much earlier, and each chromosome is split longitudinally into two. Of each pair of daughter chromo-

somes thus formed, one now passes toward one pole of the spindle and one toward the other. In the higher plants, each polar centrosphere divides into a pair at about the time of the splitting of the chromosomes. Thus finally there are accumulated at each pole as many daughter chromosomes as there were mother chromosomes formed in the mother nucleus. Each of the latter has furnished one of the former, as will be seen, to each group. The

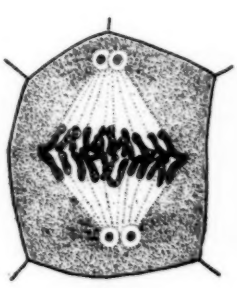


Fig. 4.

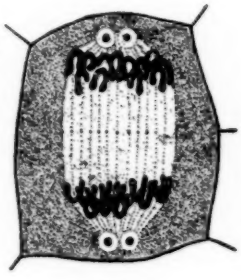


Fig. 5.

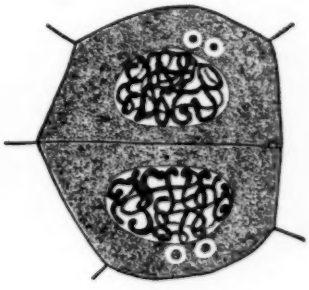


Fig. 6.

FIG. 4.—A plant cell in division, showing the nuclear spindle and the splitting of the chromosomes.

FIG. 5.—A plant cell in a late stage of division, the daughter chromosomes collecting at the poles of the spindle and the new cell wall beginning to appear.

FIG. 6.—Two daughter cells with nuclei which have nearly reached the resting stage, and each with a pair of centrosomes, the result of division of a mother cell like Fig. 1.

chromosomes of each group now fuse by their ends into a thread, and this gradually thins out until, by an inverse process to that observed at the beginning of division, it passes into the condition of a nuclear network. Meantime new nuclear membranes have been formed and two daughter nuclei with accompanying centrospheres replace the original one. Just what the mechanics of karyokinesis is has not been determined with certainty; and students of the cell are not yet agreed whether the centrospheres exert an attractive influence on the chromosomes, or are mere passive points of attachment for the fibers of the spindle.

There remains one constituent of the nucleus whose fate during nuclear division has not been discussed. This is the substance which forms the nucleoli. These bodies usually disappear slowly while the chromosomes are becoming individualized, and very commonly have quite disappeared before the disappearance of the nuclear membrane. Nothing more is then seen of them until after the constitution of the daughter nuclei and the formation of their membranes. Then nucleoli reappear within these nuclei. To what parts of the cell their substance is distributed while they are unrecognizable, and what purpose they serve in the cell economy, we do not yet know; but they are probably composed of a reserve substance which furnishes material for some formative process, perhaps for the spindle fibers, as Strasburger now thinks.

After the daughter nuclei are formed, the inclosing protoplasm divides between them, and thus there result two cells from the original one. In plants, their separation is commonly brought about by the formation of a distinct cellulose wall connecting with the original walls of the mother cell, and dividing the original compartment into two, and in most plants this wall begins to appear in the form of thickenings on the spindle fibers.

As we glance over this process of karyokinetic division just described, the phenomenon which must strike us as most significant is the longitudinal splitting of the chromosomes and the distribution of the resulting halves. Why should this exact halving of each chromosome and the invariable contribution of one half to each new nucleus be necessary? If it were merely important to divide the substance of a nucleus about equally between the nuclei derived from it, no such painfully exact method would be necessary; and, if unnecessary, we can not believe it would have been developed. Yet it is common to animals and plants of the most varying complexity of structure, and therefore doubtless of profound significance. Let us reflect that the cells of a given plant or animal possess and perpetuate the characters of that species. In case of many organisms, all or most of their cells are capable, under certain conditions, of reproducing the species to which they belong. And a given cell is always true to its kind. In other words, any cell possesses the hereditary characters of its species, which it has received from its mother cell and which it transmits to its descendants to the last generation. Two cells from two different organisms are, therefore, though indistinguishable in appearance, really as different as the organisms from which they were taken. The transmission of hereditary characters from cell to cell must, then, be definitely provided for. A little consideration will show that the evidence points at present distinctly to the nucleus as the probable seat of those characters in the cell. And, of the different constituents of the nucleus, no other has so distinct an individuality, or is so carefully divided between the daughter nuclei, as the substance of the chromosomes; while the evident need of a complete equipment of each nucleus with all the qualities of the species is quite met in its receiving an exact half of each chromosome. It is by no means proved, and it is perhaps not possible absolutely to prove, that the chromosomes are the material bearers of the hereditary characters of the species; but this view furnishes the best working hypothesis yet suggested as to the significance of the phenomena of karyokinosis. And it certainly correlates the concrete fact with the abstract problem in a most suggestive way.

In conclusion, it may be well to glance at some cell phenomena connected with reproduction. Allusion has already been made,

incidentally, to vegetative or non-sexual reproduction, which presents no further features of interest, since it differs from ordinary growth only in that the product of this form of growth does not usually remain attached to, and form a part of, the parent individual. On the contrary, it becomes separated, in most cases, from the parent, and sets out as a new individual. But in sexual reproduction we meet with a new complication. The phenomenon of sexual union, which occurs, at least occasionally, in an enormous majority of known organisms, and in very many must always precede reproduction, is essentially a fusion of two cells. And, since the male cell often consists of little more than a nucleus, it may perhaps be reduced, in its final expression, to a fusion of two nuclei. Now it is observed that the number of chromosomes in a dividing nucleus of a given species of plant or animal is approximately constant, and in the sexual nuclei quite so. After a male sexual nucleus containing, for example, twelve chromosomes has united with a female nucleus containing the same number, the fertilization nucleus thus produced proceeds to divide, and is seen to contain twenty-four chromosomes, or as many as were brought to it by both parent nuclei. And this number is found to persist without great variation in the nuclei of the new organism developed from the fertilized cell by successive divisions. It is plain that if the sexual elements produced from organisms of this generation contained twenty-four chromosomes each, those of their sexually produced offspring would have forty-eight each, and the point would soon be reached by successive doublings at which the capacity of the nucleus would be far overtaxed by the number of chromosomes. But this difficulty is avoided, in the plants and animals thus far investigated, by an abrupt reduction to one half the number usual in the organism, of the chromosomes of the nuclei of certain cells which are to give rise to the sexual cells. This reduced number remains constant in all the descendants of the nuclei in which it first appears, until the definitive sexual cells are formed. Then the fusion of two nuclei, each with the half number of chromosomes, restores to the resulting organism the typical number. This reduction has been spoken of as abrupt; and it could not well be more so. A nucleus in which it occurs receives from its mother nucleus, let us say, twenty-four chromosomes which fuse together to form its nuclear network. When, after a period of rest, this nucleus proceeds to divide, it develops from its network but twelve chromosomes, and therefore furnishes but twelve to each of its daughter nuclei. What has become of the other twelve no one can say, because nothing is known of the exact relations that exist between the individual chromosome of the dividing nucleus and any part of the network of the resting stage.

It is probable that this remarkable process of reduction has some far-reaching significance with reference to the origin and meaning of sexuality. Already theories concerning it have been suggested; but we are yet on the threshold of knowledge of the facts on which profitable theories must be based, and, until we have penetrated further within the portal, we can afford to suppress our propensity for speculation.

THE VIVISECTION QUESTION.

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I.—INTRODUCTORY.

FOR about thirty years the vivisection question has been before the public in this country. Discussion has often been hot and bitter, both in the press and in society, and again it is upon us in exactly its old form. What are we to do with it? What, so far as this country is concerned, has the controversy accomplished? After careful reading of all the important literature upon both sides, it appears to me that nothing has been gained either way. Both sides are practically where they were thirty years ago, and the failure seems to be due to fundamental misunderstandings of the real points at issue. In several hundred antivivisection publications I am unable to find a passage which reveals the least conception on the part of their writers of the real purpose which a physiologist has in his work. On the other side, while definite arguments have been advanced, no generous effort has been made to give the public a clear notion of what the physiologist in the study of health and the pathologist in the study of disease are driving at. Can something be said which shall do this? Or must physiologists work on under the distrust and suspicion of society because their aims and purposes are misunderstood?

The real question at issue, moreover, has been buried under personalities and under matters of detail, themselves involved in bitterest possible medical controversy, and the merits of which no amount of discussion, but time and experiment alone, can determine. Only by freeing the argument entirely from these things, and by placing it upon higher grounds, can we hope for intelligent peace upon this contested field. What, then, is the purpose of biological science?

Man finds himself in company upon the earth with an infinite number of living things, and he has found it of inestimable value to learn something about this maze of life. The science which

has come to embody this knowledge is now known as biology. It falls naturally into two great divisions: the study of the form and structure of organs and organisms—anatomy or morphology—and the study of the functions, of the actions, which the organs perform. This is physiology. Dividing further, physiology falls into the sciences of healthy action, physiology proper, and diseased action, pathology, from παθος, a suffering. It is evident that for the study of form alone the dead body is in general sufficient. But for the investigation of the *activities* of health and disease it is as evident that the physiologist and pathologist require vital action as much as the chemist requires chemical action or the physicist requires motion. It is continually being urged that the dead body is sufficient for every scientific purpose. As well say that the dead body is as good as a live man. It would be precisely as reasonable to agitate against driving live horses, contending that dead ones will go just as fast, as to oppose the use of live animals for physiological or pathological research. And those who make this claim prove conclusively that they have no conception of what the word physiology means.

Of all physical Nature nothing is of greater importance or touches man more closely than just this thing, life. The study of form, anatomy, is little more than a dead stepping-stone to this science of the processes of life, physiology. Young as it is, no science has attained results of greater value and none gives brighter promise for the future. In a word, the faith, hope, and charity which inspire this science are to learn enough about the laws and possibilities of living Nature, to do away with all disease and premature death, and to make all life as full and perfect as these laws will permit. This is the inspiration of biology. Is it base or unworthy? And it is not Utopian. It is possible. The end may not be attained for a hundred years or a thousand. That depends upon how much faith men have in it and upon how much effort they are willing to devote to it. But it will come as surely as the world moves.

Take for a moment a broad view of our situation in this respect. Nearly one half of our people are dying before the age of forty-one, almost all of disease, curable or preventable, did we but know how. This goes on with our standing army of physicians, over one hundred thousand strong, on duty day and night. It looks discouraging, and an eminent physician has himself said that a doctor is like a man blindfolded, striking about with a club, almost as likely to hit his patient as the disease. Our only hope, therefore, must lie in more knowledge of the laws which govern living Nature. Without this, as well attempt to stay the storm and tides of the ocean with straw as the currents of disease and the course of Nature with doctors. If we could get before un-

prejudiced, thoughtful people some idea of the magnitude and scope of medicine and its importance to human and to all animal life, together with some faint conception of the moral forces impelling to the pursuit of those sciences which underlie medicine, in the light of these ideas the vivisection question would wholly disappear.

More than two hundred and fifty years ago, in the town of Schaffhausen, a German anatomist was engaged in studying the anatomy of the human body. The people loathed him as one possessed of the devil. They told him, in the words of an old superstition, that the stain of human blood he could never wash from his hands. His reply was, "I can wash the blood stains from my hands with a basin of water, but the stain of ignorance of anatomy can not be washed from the medical profession with all the water of the Rhine and the ocean."* Wepfer spoke of anatomy. Anatomy must precede physiology and pathology, as the structure must precede the function it is to perform. Thus Anatomy must prepare the way for physiology, and to some extent she has fulfilled her mission. But were a Wepfer to arise now, he would say, "The stain of ignorance of physiology can not be washed away with all the water of five oceans." I doubt, however, whether a modern Wepfer would lay the burden of blame at the door of the medical profession. It is everyday talk that physicians must lower their practice to the ignorance and prejudice of their patients. The idea of "magic" cures is still too deeply rooted in the average mind, and a doctor must "dose" a large proportion of his patients to satisfy this craving. At no time in the history of medicine has there been such a craze for patent medicines as now, and in no country is the situation so bad as in our own. We are the laughingstock of all Europe in this regard. In Germany apothecaries are prosecuted for advertising and selling American patent medicines. What hope, then, is there for rational medicine in a country that spends yearly hundreds of millions for worthless or harmful "patent medicines" and quack doctors, and but a very few paltry thousands for the advancement of physiology—and worse still, among a people who are as completely and just as intelligently satisfied with quack nostrums as men were in the dark ages with amulets and signatures, the moss scraped from a human skull, the powder of dried toads, or the hair of a saint?† In a nation of popular rule, the only hope seems to lie in scientific education of the people. How this is to be attained is a most difficult problem. The people will not educate themselves. Against such

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* Rudolf Virchow. Archiv für pathologische Anatomie und Physiologie, vol. clxxxv, p. 375, Berlin, 1881.

† George F. Fort. History of Medical Economy during the Middle Ages, London, 1883.

education are naturally trained all the resources of quackery, whose trade would be gone. And where free expression is accorded to all alike, progress must be made in the teeth of ignorance too dense to have any conception of its own depth, and in the face of brawling charlatanry and screaming fanaticism. With nearly half our people dying before or about the prime of life, this is the situation. To teach ideas of cause and effect with reference to matters of health and disease, to inspire at least a willingness to heartily co-operate in efforts to control the causes of disease, our public-school system seems well adapted. But even here there is a serious tendency to hamper and restrict the proper teaching of physiology.

II.—VIVISECTION FROM THE STANDPOINT OF RELIGION AND MORALITY.

If vivisection is impious, immoral, or demoralizing, it must be abandoned as a method of research, and further discussion on grounds of utility is precluded. Hence this aspect of the subject must receive our first attention. Scarcely a paper appears against the practice of vivisection which does not contain solemn appeals to the Deity. These are too sincere to be ignored. In fact, the most active supporter of the agitation in England would confine the discussion wholly to these grounds, and invites us to "leave, then, utility alone, and all the weary controversy which hangs upon it." With the help of God, it (the national conscience) will yet abolish vivisection.* A recent expression of the American Society is as follows:

Resolved, That we, the American Antivivisection Society, believe vivisection to be morally wrong; to be distinctly opposed to the intent of a beneficent Creator, who wills the happiness of all his creatures; that we should, as Christians, unite in every effort for its suppression, and, as the best weapon of the Christian is prayer, *Resolved*,† etc.

The argument has been cast by Cardinal Manning into the following syllogism: Truth of Nature must be sought only by methods in harmony with the perfection of Nature's God. Mercy is one of the perfections of God. Vivisection is not in harmony with perfect mercy.‡ Therefore truth must not be sought by vivisection. How the worthy cardinal knows that vivisection is not in harmony with God's perfect mercy he nowhere explains. This is the all-important question. If this proposition is true, vivisection is impious, and must be abandoned immediately, no matter what its value to science, or utility to mankind.

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* Miss F. P. Cobbe. A Charity and a Controversy, London, 1889, p. 4.

† American Antivivisection Society Report, 1892, p. 19.

‡ Manning. Annual Address, Victoria Street Society, March 29, 1887.

Clearly the only way to find an answer to this question is to go to Nature itself and examine the principles upon which God has deemed it wise to order the living population of the world.

Doing this, we find living upon the world at present at least 272,090 different species of animals, the number of individuals in each species being beyond computation or expression. We also know that 39,925 species, with their countless numbers of individuals, have succumbed in the struggle for life and become extinct.*

Now, it has been ordained, in the perfect mercy of God, that each individual of this innumerable population be born, live for a little time, and die. With many species, birth itself is painful. With all, life is a continuous struggle and terminates in what is commonly called "the agony of death." Few, at least of the higher animals, struggle out the full measure of their days and die in peace. The vast majority are starved to death, or famished and scorched to death by heat and drought, buried in the burning *débris* of volcanoes or in snows and frozen to death, or are beaten to death by hail or drowned in floods. And in and through all this is the desperate struggle to find a grain of food, a drop of water, a little shelter, a foothold in the flood, a way out of the fiery hail or burning forest.

But harsh as is the relation between animal life and the physical world, still more severe are the relations of animals to one another. Here we see the weaker preyed on by the stronger mercilessly, and behold the array of vivisectional instruments—the teeth and jaws, the beaks and talons, the claws and fangs, developed for this purpose. Here the animals that escape the accidents of the physical world perish most miserably, are lacerated, torn limb from limb, are slowly crushed in serpents' coils or slowly swallowed alive. And again in all this is the last, probably of many, flight for dear life, the last convulsive effort to tear loose from the teeth or talons. Certain plants, even, are carnivorous, and entrap and digest living animals. More than all this, among certain animals, the males fight to the death for possession of the females of the species.

Still more terrible, many animals and plants become parasitic, and suck from day to day the life-blood of their hosts. Undoubtedly the greatest distress to which the animal kingdom is subjected occurs under this head. Some of the many diseases producing microbes become established in the animal. The dis-

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* Leunis. Synopsis der Thierkunde, vol. ii, p. 1176, Hanover, 1886. The above is merely the number of species known to Leunis in 1886, and by no means the entire number inhabiting the earth. Lord Walsingham estimates that there are upward of two million species of insects alone. (Entomological News, April, 1890, p. 58.)

ease ensues—slow, loathsome decay, sharp, convulsive torture, or the burning to death of fever.

All this is going on in the sea and on the land and has been going on for geological ages upon a scale which baffles expression in number or quantity. And this is God's ordering of Nature in "perfect mercy." With it man has had nothing to do, since there is every reason to believe that it existed ages before he appeared upon the scene. Cardinal Manning goes on to tell us that he believes in Genesis; but there we are told, "And God saw everything that he had made: and behold, it was very good." According to any estimate of the enormity of physical suffering which I have been able to find among antivivisection writers, the God who ordained such a scheme of Nature must be a monster of cruelty. What is wrong with the equation? The Creator? Nature? Or the ideas of antivivisectionists? Is it not true that the religion of a hermit's hut, a lady's parlor, or a pope's palace is apt to fit ill the problems of the wide world, and that we must go to Nature to study even religion?

This travail of the animal creation is the "Slough of Despond" for every philosophy but one. The biologist would agree with the Creator in pronouncing it "very good." He too has gained in some degree the divine point of view, and can see that out of the struggle comes the quickening to nobler form and higher life, and that, without this, life of any sort is scarce worth the living.

Few who drive thoroughbreds ever pause to think of the fleeing for life, through geological epochs, the kicking and biting, the hardship and training it has cost to give to the horse his beauty and strength, since the time when the fox-sized *Eohippus* picked his way among Eocene bogs. So with man, so with every form of life that has attained any height of development. The price has been great, but the gain is priceless; and we would not give back, if we could, all the suffering the world has felt and revert to vegetation and formless slimes.

Examining a step further, is it not possible to imagine a more merciful dispensation of Nature? Suppose all the "cruel" carnivora should be exterminated or become vegetarian. Would we not then have the animal millennium of certain sentimental people? No, far from it. The ensuing year would be the most dreadful in the experience of the animal kingdom upon the earth, and would end in death by starvation and disease of many more animals than are now annually appropriated by the carnivora. But suppose all manner of disease should be done away with—the millennium of scientific medicine; the struggle for food would be only the more terrible, and it is more merciful to kill in a night, even by pestilence, than in a month by starvation and the kicks and butts of stronger animals.

There is what is known as the "balance of natural forces." It is this that keeps the planets balanced in their orbits, and among animals it holds the species within the bounds which make for the greatest happiness of the greatest number. It is the plan of an all-merciful Creator, and man has never been able to suggest an improvement upon it, within the limits of physical conditions.

From the above, we see that every animal life is cast into the world *as an experiment*, often of the severest and most painful type. In this lifelong vivisection, Nature provides no ether or chloroform, nor even chloral or morphine.

By this very dispensation of Nature God clearly gives to man every sanction to cause any amount of physical pain which he may find expedient to unravel his laws. Not only this, the situation places upon man heavy duties, which he is bound to perform. These we will consider in a moment. As far as biological science is concerned the whole argument may be summed up as follows: Biology is not an exact science like mathematics and physics. These sciences are exact simply because it is possible in them to obtain as many equations as there are unknown quantities to be determined. Hence, with the solution of all possible equations, every unknown quantity in these sciences may be exactly determined. In biological sciences the case is thus far quite different. Here the unknown quantities are legion in every equation. Hence the extreme difficulty of any solid advance; hence the many mistakes, the many disagreements. In the best of experiments it is only possible to mass one series of unknown quantities against another series of unknown quantities so that they balance as nearly as possible, and then with our one unknown quantity, about which the experiment turns, make the best temporary solution of our problem possible. Thus the science must be content to proceed until the vast series of unknown conditions which influence life have been dealt with one by one. Thus, if the science is to advance, if we are ever to learn under what conditions life is most favorably placed, we must vary the conditions in every possible way—i. e., *experiment physiologically;* and, as we have seen, everything in the divine ordering of Nature is in complete harmony with this method, and bids man Godspeed in this great work.

Thus far we have considered Nature as uninfluenced by the presence of man. Let man, a moral being, take his place among the animal creation, and at once there spring up moral relations between him and every living thing capable of feeling pleasure and pain. It becomes his duty to do all in his power to increase the happiness and to diminish the suffering of every sentient thing. But we do not sympathize with the Hindu who lay down before the starving tigress in order to save her life and the life of

her whelps with his own. Man's first duty is to those of his own species. If wild beasts endanger the life of his wife or child, it becomes his duty to kill them by any means in his power, let the suffering be what it must. This is man's first step in the conquest of any country. And when he has rid the earth of the fierce carnivora, it becomes his duty to kill such numbers of the herbivora as will enable the rest to obtain food and enjoy life. This surplus man has always utilized for food and clothing. All this, however, is but his first step. He must tend herds and till the soil to support as many as possible of his own species. Even then his work is but just begun. If disease threaten the life of his child, is his duty any different? Certainly not. It is as much his duty to exterminate the disease as to destroy the wild beast. To subdue the earth, "and have dominion over . . . every living thing that moveth upon the earth," was one of God's first and highest commands to man; and it includes microbes as well as lions and tigers.

At just this point we are met with the argument that there is no moral proportion between the amount of suffering caused by vivisection and the advantage gained. "Suppose it is capable of proof," says Lord Coleridge,* "that by putting to death with hideous torment three thousand horses you could find out the real nature of some feverish symptom, I should say, without the least hesitation, that it would be unlawful to torture the horses." Accepting the proportion as stated, we will have: Torture of three thousand horses is to knowledge of real nature of feverish symptom as power gained by such knowledge is to prevention of death annually from splenic fever, we will say, of many millions of cattle, horses, and sheep, and thousands of men in Europe. There is no very exact "proportion" between end and means, but Nature is too generous to insist on exact "proportions" when men study her laws aright.

The difficulty with good people who reason out this "proportion" is that they fail to grasp the stupendous size of the problems involved, the whole world over and through all time. France alone is estimated to lose sheep to the value of four million dollars annually from splenic fever, and in one district, Beauce, one hundred and eighty-seven thousand sheep are killed annually by it. In Russia, during 1857, it was reported that one hundred thousand horses perished from the disease. In other epidemics, the losses within small districts reach tens of thousands, and in one a thousand people caught the disease and perished.†

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* Coleridge. The Nineteenth Century Defenders of Vivisection, p. 8.

† R. M. Smith. Therapeutic Gazette, November, 1884; and George Fleming. Vivisection and Diseases of Animals. Nineteenth Century, 1882, p. 470.

Or suppose it to be a "knowledge of the real nature of some symptom" of one of the fevers that are yearly causing in this country the premature death of nearly fifty thousand people,* and the knowledge gained saved the life of but one, the proportion would still stand approved in the minds of all humane people. I am aware that Miss Cobbe has said in effect, Our days are numbered, and I would not have my own or those of my friends spared or lengthened by the suffering of animals. This sentiment is sanctioned by no code of Christian ethics. For all normal, rational, and truly humane people the following statement of Prof. Davis is true beyond danger of cavil. He says: "When the brute's ordinary right to welfare, yielding exemption from inflicted pain, confronts man's right to welfare, it (the welfare of the brute) shrinks to zero and disappears." †

In order to test the popular acceptance of this principle, I actually put the following question to twenty American women: "Let the suffering be any amount necessary, how many dogs and cats do you feel that you would give to save the life of one human being?" Without exception, these women have answered, "*I would give all the dogs and cats in the world.*"

Contrast with this the following sentiments from the pen of a woman who is perhaps the most active agitatrix of antivivisection in this country. She answers as follows: "How many human lives which you 'experimenters' are so anxious (apparently) to prolong are really worth the time and trouble? . . . Would the world not be benefited were they allowed to pass to another sphere, where perhaps the conditions would be more favorable to moral and spiritual advancement?" Such perversion of human sentiment is little, if any, short of the pathological, and calls for no further comment.

Thus is seen the impossibility of separating morality from utility. If the right of the animal stand in the way of human use, "it shrinks to zero." If one human life can be saved, any amount of animal suffering necessary is justified. With this noble sentiment we thus accept the burden of proving that the sacrifice of animal life has brought us knowledge by which the human life has been prolonged and the sufferings of humanity have been ameliorated. With this proved, it is clear that it may be as much the moral and religious duty of a man to vivisect, who has faith that he can advance the cause of humanity by so doing, as it is his duty to preach or teach who has equal faith in these occupations. We shall treat the argument for utility in

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* Compendium of the Tenth Annual Census, pp. 1708, 1709.

† Prof. Noah K. Davis. The Moral Aspects of Vivisection. North American Review, 1885, p. 217.

the succeeding chapter. Before passing on to this head, however, two moral questions, fundamental to the whole discussion, must be carefully considered.

An assumption found in every, or almost every, antivivisection argument is that vivisection must be demoralizing to those who practice or witness it. Neither fact nor proof is adduced. From beginning to end it is pure tissue of antivivisection imagination, like the old assumptions against the first anatomists. The assumption is not only unfounded but thoroughly irrational. It would be precisely as sane to assume that a missionary who goes to preach among the heathen tends to become heathenous; or that anything in the practice of surgery or medicine tends to blunt the sensibilities of men in these professions. Granting that there are brutal men in the medical profession, as there are in all others, carries no proof that their work has made them so. It may have made them decidedly more humane than they ever would have been without it.

On just this point I have taken the pains to collect the testimony of experienced teachers of physiology in thirteen institutions in this country, where the greater part of our vivisectional work is done. In every case the moral effect of experimentation is claimed to be wholesome, and in no case have they any evidence of its being evil. I will quote from but one instance, the experience of a professor in an institution for the higher education of women. He writes: "In numerous cases students have entered the course with decided objections to the practice of vivisection; and in no case, so far as I know, have they left without the removal of their objections and the substitution for them of sound views as to the necessity and value of vivisectional work."

The other question is one which touches the bed rock of human life: What is the use of living anyway? It is Franklin's old question, "What is the use of a baby, unless it is to become a man?" but with the added question, What is the use of the man? A good many people every year look their lives in the face in this way, and, deciding that this life is of no use or worse than no use, put an end to it.

Furthermore, What is, or what may be, the value of a man's life work? And how far have we the moral right to pass judgment as to the value or use of another's life or work? With the earth reeking in carnage and with humanity and animate Nature writhing in pain, how is it possible to say that God has ordered Nature wisely and mercifully? And taking Nature as we find it, what can man do about it?

One theory has always been that the forces of Nature and life are far too vast for man's feeble powers to influence for good or

for ill; that his chief duty lies in resignation to fate. Directly opposed to this is the spirit of modern science, which considers it man's duty to go to work and manufacture fate. What right, it would ask, have we to assume that the forces of Nature are difficult of control until all the laws which govern them are investigated? Numberless instances in the history of science prove that his powerlessness is a mere bugbear of man's own imagining. It may be so in all cases. If man will only put forth a reasonable amount of effort, it may not be so difficult to comply with the command, "Subdue the earth."

Still, the old superstitions cling tenaciously to the best of men. A child sickens and dies, and we say, "It is the will of God, so let it be." What right has man to lay this flattering unction to his lazy soul? The scientific spirit would say: "It is the ignorance of man. It is his duty to learn enough about this disease to prevent or cure it." In taking this position science simply accepts the universal principle that ignorance of law does not exempt from penalty, and hence would study the law under which the calamity occurred and, by obedience, escape the penalty in future.

To conclude in a sentence the result of a chain of reasoning too long to even outline in detail, all the suffering and physical evil in living Nature finds ample justification for its existence if, serving as a spur to man, it arouses him to use his intelligence and put forth every energy available to alleviate the misery of the world and improve its condition. In other words, Nature is *wisely* ordered to give *man plenty to do*, and to do this work is one of his highest duties. How he is to accomplish it, depends upon the means he finds at hand, which prove themselves useful to his purposes.

In passing to a consideration of the utility of scientific experimentation, it must be remembered that we are not discussing the question with infanticides, murderers, or would-be suicides. It can be considered only with those who believe that, after moral excellence, human life and happiness and freedom from disease are the most useful things in the world.

A SPELÆOLOGICAL society has been formed in France, at the instance of M. E. Martel, for the study of everything relating to caves, including artificial ones. At the end of December, 1895, it had one hundred and seventy-five members. It publishes a quarterly bulletin, *Spelunca*, and Memoirs, of which three numbers have been issued. It has endowment members, who contribute not less than four hundred francs; titular members, who pay fifteen francs a year; life members, who make a single contribution of two hundred francs, and corresponding members, who pay five francs a year. The general secretary is M. Martel, rue Ménars 8, Paris.

IMMIGRATION AND CRIME.

By SYDNEY G. FISHER.

THE criminal influence of the alien with its steady increase can be traced back in our history for the last sixty years. So surely and yet so gradually has it grown upon us that we have now become thoroughly accustomed to a condition of things which would have been extremely shocking to our rugged ancestors as they are sometimes called.

When our system of foreign immigration first began to reach serious proportions, about the year 1820, its effect on our manners and morals soon attracted attention. The Native American party, which arose soon after 1840, based its strongest argument on the enormous increase of crime which followed the advent of the foreigners. The belief and confidence in the cheap labor of the immigrant were very strong in those days, or the people would never have been willing to go on with the system in the face of the shocking revelations of pauperism, crime, and corruption which became more and more apparent from 1830 to 1850.

The newspapers and pamphlets of that time published statistics which showed that, although the foreign population was only an eighth of the whole, yet it furnished two thousand more paupers and a thousand more criminals than all the remaining seven eighths of the people. Every thirty-two foreigners produced a pauper, and every one hundred and fifty-four of them produced a criminal; but it required three hundred and seventeen natives to furnish one pauper and sixteen hundred and nineteen to furnish a criminal.

The census of 1880 attempted to summarize the relative proportions of the foreign population which were paupers and criminals as far back as 1850. The statistics on which the calculation was based were somewhat incomplete, but so far as they go they show the same result that all other similar investigations have shown. The foreigner in proportion to his numbers furnishes by far the greater part of pauperism and crime.

Ratio to 1,000,000 of Population.

	1880.	1870.	1860.	1850.
Paupers:				
Native	994	1,635	1,849	1,765
Foreign	3,438	4,095	7,843	5,986
Prisoners:				
Native	1,054	733	371	207
Foreign	1,917	1,568	2,161	1,074

The Massachusetts census of 1885, which was taken with great care and completeness, shows the same condition of affairs. The foreign born of that State were 27·1 per cent of the whole population, and yet they furnished 44·03 per cent of the paupers, 40·60 of the prisoners, and 36·87 per cent of the convicts.

If we take the statistics of the children of foreigners the result is almost the same. The people of foreign parentage in Massachusetts are 47·36 per cent of the whole, yet the number of prisoners with both parents foreign born was 60·30 per cent, and the number of convicts with both parents foreign born was 51·14 per cent.

The statistics of the national census of 1890 reveal the same condition. The native white element of the population is 54·87 per cent, but it produces only 43·19 per cent of the white prisoners. The foreign white element, counting foreign born and the children of foreign born, is only 32·93 per cent of the population, and yet it produces 56·81 per cent of the white prisoners.

The statistics may also be stated by ratios per million in each class so as to include the negroes, which gives a still more striking result:

Prisoners.	Ratio per 1,000,000.
Native white	882
Foreign white	1,747
Negro	3,250

The negro, though born on the soil, is in every sense an alien, and if we wish to see how much crime is due to our various experiments in importing foreign populations we have only to connect the negro ratio of crime with the foreign white ratio and compare them with the native ratio. The result can be seen by a glance at the above table and is rather startling.

We hear a great deal about the crime of murder in the United States and its great increase, and it may be interesting to know the source of a large portion of it. Our population is now divided into native white, foreign white, negro, Chinese, Japanese, and civilized Indians; and the census of 1890 shows the percentage of homicide to be assigned to each in proportion to percentage of population:

Population.	Percentage of population.	Percentage of homicides.
Native white	73·24	44·00
Foreign-born white	14·56	16·40
Negroes	11·92	37·11
Chinese and Japanese	0·17	1·28
Civilized Indians	0·11	1·21

The natives, it will be observed, though almost three fourths of the population, commit less than half the homicides; while the aliens, including in that term the negroes as well as the foreign born, though only about one fourth of the population, commit more than half the homicides.

How many of the murders committed by natives are due to the example and presence of the foreigners can not be estimated, but it is doubtless no small proportion.

The number of murders committed by the black race is very large. Out of the 7,386 prisoners indicted for homicide, 4,425 were white and 2,739 were negroes. In point of numbers the negro population is less than a seventh of the white population, and yet the negroes commit more than half as many murders as the whites.

In counting up the cost of the foreigner, in addition to what he kills, burns, and destroys, it may be well to mention the charge we are put to in maintaining his paupers, a service which we have now performed for him for many years with great generosity in our almshouses. Census Bulletin No. 90 has it in a nutshell: "The foreign population of this country contributes, directly or indirectly, in the persons of the foreign born or of their immediate descendants, very nearly three fifths of all the paupers supported in almshouses." In other words, although the foreign element is much less than half of the whole population, it nevertheless furnishes more than half of the paupers. If we leave out the pauper descendants of foreigners and count merely the foreign-born paupers, we find that they alone outnumber the native paupers.

The original native population of the United States, which fought the Revolution and built up the country for the next fifty years, was remarkably free from the habit of settling every petty dispute by homicide, and yet a large part of them were people who may be said to have passed their lives with firearms in their hands. They were hunters and Indian fighters, and they were all familiar with war, whether against the French, the Indians, or their own race in the Revolution; but in their personal disputes among themselves they seldom attempted to kill. The frontiersman of that period usually settled quarrels with his fists. In the Whisky Rebellion of 1794, which was long continued and serious enough to have an army sent to suppress it, the rioters did not take a single human life. They tarred and feathered some of their enemies, shaved their heads, and indulged in other rough treatment. Even after two or three of their number had been shot by the authorities they showed none of that anxious desire for killing that now characterizes rioters.

When the dispute between Connecticut and Pennsylvania for

the possession of the Wyoming Valley had been settled by a legal decision soon after the Revolution, the Pennsylvania Legislature passed an act in 1787 organizing the valley as a part of Pennsylvania. A meeting of the Connecticut settlers in the valley was called to decide whether they should accept the act. There were two parties among them, one in favor of the act, the other against it, and in the heated discussion of the meeting they came to blows. After the first blow was struck each party rushed, not for their guns, but for sticks, which they cut from the neighboring trees, and for a time there was a very savage contest; but not a single shot was fired nor was there a single blow given with a knife, and after a while they came together again and passed a resolution accepting the act. Yet they were all frontiersmen, accustomed to the almost daily use of rifles and hunting knives.

About the time of the Revolution there were riots in Boston, New York, and Philadelphia, and much property was destroyed; but in only one, the riot in Philadelphia over the depreciation of the Continental currency, were lives taken. The same characteristics prevailed in Shays's Rebellion in Massachusetts.

The first riots in which an intense desire to use firearms and kill was shown were the Catholic riots of 1844, which were begun by foreigners firing into a meeting of native Americans. From this we have gone steadily on, until we now have more rioting, bloodshed, and murder in a single year, or even in six months, than can be found in a hundred years of our previous history, and in almost every instance it can be traced to the alien element in our population.

Washington, in writing on the subject of immigration, said:

> My opinion with respect to emigration is that, except of useful mechanics and some particular descriptions of men or professions, there is no need of encouragement; while the policy or advantage of its taking place in a body (I mean the settling of them in a body) may be much questioned. (Works, xi, p. 2.)

On another occasion he wrote:

> It is not the policy of this country to employ aliens where it can well be avoided, either in the civil or military walks of life. (Works, xi, pp. 392, 393.)

Jefferson, though belonging to the party opposed to Washington, had very much the same opinion:

> They will bring with them the principles of the government they leave, imbibed in their early youth, or, if able to throw them off, it will be in exchange for an unbounded licentiousness, passing, as is usual, from one extreme to another. It would be a miracle were they to stop precisely at the point of temperate liberty. These principles, with their language, they will transmit to their children. In proportion to their numbers they will

share with us the legislation. They will infuse into it their spirit, warp and bias its direction, and render it a heterogeneous, incoherent, distracted mass. I may appeal to experience during the present contest for a verification of these conjectures. But if they be not certain in event are they not possible, are they not probable? Is it not safer to wait with patience twenty-seven years and three months longer for the attainment of any degree of population desired or expected? May not our Government be more homogeneous, more peaceable, more durable? Suppose twenty millions of republican Americans thrown all of a sudden into France, what would be the condition of that kingdom? If it would be more turbulent, less happy, less strong, we may believe that the addition of half a million of foreigners to our present numbers would produce a similar effect here. If they come of themselves they are entitled to all the rights of citizenship, but I doubt the expediency of inviting them by extraordinary encouragements. I mean not that these doubts should be extended to the importation of useful artificers. The policy of that measure depends on very different considerations. (Works, viii, p. 330.)

The prophesy in the above passage has most certainly come true; and the last two sentences are also worth considering. "I mean not," he says, "that these doubts should be extended to the importation of useful artificers. The policy of that measure depends on very different considerations." This will at once be recognized as agreeing exactly with Washington's words where he says, "that except of useful mechanics and some particular descriptions of men or professions there is no need of encouragement." Washington, though strongly opposed to the admission of foreign officers in the army, had made exceptions in the case of certain artillerists and engineers, who he said were needed to teach us some of the fine points of gunnery and construction, and in his objection to immigration in general he made exceptions in favor of certain kinds of skilled labor.

In short, these Fathers of the Republic were entirely opposed to promiscuous, wholesale immigration, and they undoubtedly represented the opinions of a large number of our people at that time. The importation of paupers, vagrants, and criminals, together with hundreds of thousands of men and women capable only of cheap manual labor, was altogether foreign to their thoughts, or, if they contemplated it at all, it was only to revolt from it. Even Madison, who favored immigration more than any of the other fathers of the republic, and who introduced in Congress the first bill intended to encourage it, always insisted that he intended to bring over only the "worthy part of mankind," and in a letter written in 1813 he expresses almost the same opinion as Washington and Jefferson:

I am obliged at the same time to say, as you will doubtless learn from others, that it is not either the provision of our laws or the practice of the Government to give any encouragement to emigrants unless it be in cases

where they may bring with them some special addition to our stock of arts or articles of culture. (Works, ii, p. 576.)

Neither Madison nor any of the others had any conception of modern immigration, and apparently never realized that their moderate and, as they supposed, well-regulated encouragement would bring it about.

ILLUSIONS AND HALLUCINATIONS.

By Prof. WILLIAM ROMAINE NEWBOLD.

I HAVE already had occasion more than once to speak of the development of a mental state from the stage which we term *idea* to that which we term *sensation*. Before taking up the matter in hand it will be necessary to go into this question at somewhat greater length.

We seldom have difficulty in discriminating an idea from a sensation, but it is not easy to define the difference between them. This is partly due to the fact that the differences are very complex, and partly to the fact that they vary in the respective fields of sensation, so that one can scarcely frame a definition for ideas and sensations of vision that will also prove applicable to those of sound, touch, and so on. Ideas of sound differ from the corresponding sensations chiefly in intensity, but in the case of vision a much more important distinction is drawn from the relation sustained by visual ideas to what the eye actually sees. At the present moment I am thinking of something I saw yesterday, but what I see with my eyes is not in the least affected by that. The two groups remain distinct, and it would seem as if an almost impassable gulf parted them, so seldom does a bit of one become confused with the other. This is not true of ideas of sound. If they only become intense enough they may seem to blend with real sounds—indeed, I often mistake an air of which I am thinking for the same air faintly heard.

The distinction between sense-impression and idea really rests upon intrinsic differences of this kind, but as they are so complex I shall make use of a physiological distinction which for all practical purposes coincides with it. Sense-impressions are those mental states which are primarily initiated by a current from the outlying regions or periphery of the body, especially from the organs of sense. Since these currents are usually due to the action of physical forces upon the body, sense-impressions generally give us information as to the condition of the material world. All other mental states should be classed as ideas, even though they simulate sensations so closely as to be scarcely distinguishable from them.

From this point of view the peculiar characteristics of the impressions of sense are due to some peculiarities in the cortical processes which are their physical bases—peculiarities which are usually due to the action of a peripheral current. Thus it may be that the sensation is more intense because the current acts upon the stored-up energy of the cortical cells much as a spark acts upon gunpowder. If precisely the same kind of a cortical process could be induced in any other way than by the action of a peripheral current, we would presumably have an imitation sensation. There appears no good reason why there should not be many other kinds of cortical processes intermediate between those that underlie ideas and those that underlie sense-impressions, and to them mental states should correspond which are betwixt and between—neither fish, flesh, nor fowl.

Now, of the cortical processes we know nothing; I use them merely as symbols for mental facts. But the mental states we directly know, and it is quite certain that many different types of them exist, roughly corresponding to what we would expect if the above conception were true. We know that in different individuals ideas vary much in their clearness and in the degree to which they approach sensations. In the same individual they occasionally assume a form which is to him almost like a glimpse into a new world of experience. My own visual ideas, for example, are very vague and dim, and I shall never forget the two or three occasions in my life when they have for a while been vivid and brightly colored, somewhat as my visual sensations are. And occasionally we meet with experiences which are certainly originated largely or entirely from within and must be classed as ideas and yet resemble sensations so closely that they can be discriminated from them only upon reflection. These are what we term illusions and hallucinations; the other types, which we never mistake for realities, although they resemble sensations so closely, are termed pseudo-hallucinations. By the level or grade of a mental state I mean the degree to which it approximates that fullest and most perfect form of being which we find in the sense-impression, and by development I mean the process of becoming more like the sense-impression.

What can cause development? Well, in the first place, it can be caused in some individuals by concentration of attention. Most of my readers have heard the story of the painter who said he could at any time see again a sitter by looking at the chair in which he had once sat. I have met many such persons. Sometimes the process is slow and its several stages can be traced. Miss Z——, for example, after fixing her thoughts upon the image of a friend, sees a shadow appear before her which gradually assumes color, consistence, solidity, reality, and finally becomes the

living image of the friend. But with the least distraction it vanishes like a soap bubble. In other cases the process is instantaneously completed. Rev. Mr. F—— can at any time by an act of will create an image of a friend, and after doing so finds it hard to lay the ghost which he has himself raised. Images voluntarily externalized nearly always seem subject to curious limitations. Often it is possible to externalize persons only, or only certain persons, or only in definite attitudes. The apparition rarely appears possessed of independent life, it seldom moves spontaneously, and its features reflect no play of thought; it also often disappears upon being touched. All these are common traits of ghosts, and the identity goes to show their common origin.

In the second place, the development of an idea is sometimes clearly traceable to a simultaneous but disconnected sensory stimulus. A striking illustration of this fact fell within my own experience not long ago. I had had a fatiguing and anxious day, and consequently could not sleep. As I lay in bed, dim, silhouette-like forms began to outline themselves in the darkness, as sometimes, although very rarely, happens when I am tired and excited. I was trying to make one out, when I heard a crackling sound. Instantly the shadowy image was illumined by a brilliant flash of white light, and I saw two dumb-bells lying crossed with the balls toward me. For a moment my impression was that some one had brought a light into the room, although my eyes were closed; but upon opening them I found that my brother had entered without a light through a Japanese screen made of slender wooden rods strung lengthwise. The crackling sound made by the parted screen had raised my thought-image to sensory intensity. Parish gives another good illustration.* A physician, while experimenting in this line, thought of a section of liver and tried to see it, at the same time pressing on the ball of the eye. "At first he was clearly conscious that his mental image was quite dim and confused; yet suddenly an image of a section of liver stood before his eyes as if seen through a microscope, clearly outlined, and with all its arteries, veins, and gall ducts beautifully colored in red, blue, and greenish violet."

In the third place, the degree of vividness which a mental state attains seems to bear an inverse relation to the number of ideas which it suggests. I can not go into the proof of this statement here, as it would lead me too far astray into the field of normal psychology, but those who care to follow it out will find it set forth by Prof. James in his Psychology, volume ii, page 124. It is also true that hallucinations are common in states in which

* Ueber die Trugwahrnehmung, p. 134.

there seems to be an arrest of the processes of association. Such are, for example, all hypnotic states. The analogy to the forms of transmission of physical energy is striking, and has led Prof. James to conjecture that the higher development of the few ideas remaining is in some way a compensation for the arrest of association. "If," he says, "we regard association paths as paths of drainage, then the shutting off of one after another of them as the cerebral paralysis advances ought to act like the plugging of a hole in the bottom of a pail, and make the activity more intense in those systems of cells which retain any activity at all." Prof. James then quotes from Taine a vivid description of the rise in the level of the idea trains as the association paths are closed by sleep. "All external sensations are gradually effaced, or cease at any rate to be remarked; the internal images, on the other hand, feeble and rapid during the state of complete wakefulness, become intense, distinct, colored, steady, and lasting: there is a sort of ecstasy, accompanied by a sense of expansion and comfort. Architecture, landscapes, moving figures, pass slowly by, and sometimes remain with incomparable clearness of form and fullness of being; sleep comes on, and I know no more of the real world I am in. Many times, like M. Maury, I have caused myself to be gently roused at different moments of this state, and have thus been able to mark its characters. The intense image which seems an external object is but a more forcible continuation of the feeble image which an instant before I recognized as internal; some scrap of a forest, some house, some person which I vaguely imagined on closing my eyes has in a minute become present to me with full bodily details, so as to change into a complete hallucination. Then, waking up on a hand touching me, I feel the figure decay, lose color, and evaporate; what had appeared a substance is reduced to a shadow. In such a case I have often seen, for a passing moment, the image *grow pale*, waste away, and evaporate; sometimes on opening the eyes a fragment of landscape or the skirt of a dress appears still to float over the fire-irons or the black hearth."

In the three types which I have been discussing, the mental state was present as a thought before being externalized as a hallucination, and for many reasons hallucinations of this type are the most instructive. But very often the hallucination is not only not a mere externalization of a thought already present, but has no apparent connection with anything of which the patient is at the time thinking. Hence the theory of development needs to be supplemented by other considerations, and one may draw them from either of two quite different, although I think not inconsistent, points of view. In the first place, one may suppose that the hallucination is sometimes initiated from without, through some

derangement in the mechanism of perception, and has nothing to do with what the patient is thinking of. In the second, one may have recourse to the theory of subconscious states and assume that every hallucination had a true mental existence, if not conscious, then subconscious, before being brought to the upper consciousness. The first is the old orthodox theory of illusion, and, to make it intelligible, I must say a little of the normal processes of perception.

Our sense-impressions are primarily initiated, as I have said, by currents from the periphery of the body, but their final complexion is only in part determined by the peripheral currents; it owes much to the condition in which the cortex happens to be and to the manner in which it is constituted. We may roughly compare it to a penny-in-the-slot machine. Without the penny there would be no response, but the precise character of the response is determined by the constitution of the machine. The case of the brain is similar, but infinitely more complex. Most of our sense organs send in very complex currents: from the eye, for instance, we get currents which, taken alone, would cause sensations of color, touch, and movement—the slightest change in the number and relative adjustment of these currents, even though it be so slight that we can not possibly be aware of it as a change in the simpler sensations, will totally change the character of the sense-impression. These sensory currents are like the keys and stops of an organ, and any one who knows just what stops and keys to manipulate can get any response he pleases. Thus the technical part of painting consists in so imitating the ordinary sensory determinants of vision by means of colors on a flat surface as to produce that cortical process which is usually produced by a real thing.

It is not often possible to trace the operation of these factors in our sense-impressions. Each seems an indivisible mental whole. But sometimes we can distinguish them. In the first and third of the three types of hallucination which I have already analyzed, the character of the hallucination is clearly determined by the first or central factor, and its development also seems to be due to some central factor or factors. In the second of the three the character is determined as before by the central factor, while its development to sensory intensity is due to its accidental coincidence with the arrival of a sensory current, which is a peripheral factor. These are all termed hallucinations centrally initiated, or true hallucinations. In the types which I shall now take up the character is always chiefly determined by peripheral currents, and, presumably, they are also responsible for the sensory intensity of the image. These hallucinations are termed peripherally initiated, or simply illusions.

The following account may be taken as typical of the true illusion:*

"One evening, at dusk, I went into my bedroom to fetch something I wanted off the mantelpiece. A street lamp threw a slanting ray of light in at the window, just sufficient to enable me to discern the dim outline of the chief articles of furniture in the room. I was cautiously feeling for what I wanted when, partially turning round, I perceived at a short distance behind me the figure of a little old lady, sitting very sedately with her hands folded in her lap, holding a white pocket handkerchief. I was much startled, for I had not before perceived any one in the room, and called out 'Who's that?' but received no answer, and, turning quite round to face my visitor, she immediately vanished from sight. 'Well,' I thought, 'this is strange!' I had left all the rest of the household downstairs; it was hardly possible that any one could have followed me into the room without my being aware of it, and besides, the old lady was different from any one I had ever seen. Being very near-sighted, I began to think my eyes had played me a trick; so I resumed my search in as nearly as possible the same position as before, and having succeeded, was turning to come away, when lo! and behold! there sat the little old lady as distinct as ever, with her funny little cap, dark dress, and hands folded demurely over her white handkerchief. This time I turned round quickly and marched up to the apparition, which vanished as suddenly as before. And now being convinced that no one was playing me any trick, I determined to find out, if possible, the why and because of the mystery. Slowly resuming my former position by the fireplace, and again perceiving the figure, I moved my head slightly from side to side, and found that it did the same. I then went slowly backward, keeping my head still until I reached the place, when, deliberately turning round, the mystery was solved. A small polished mahogany stand near the window, which I used as a cupboard for various trifles, made the body of the figure, a piece of paper hanging from the partly opened door serving as the handkerchief; a vase on the top made the head and headdress, and the slanting light falling upon it and the white curtain of the window completed the illusion. I destroyed and remade the figure several times and was surprised to find how distinct it appeared when the exact relative positions were maintained."

In this case the form of the illusion seems to have been almost entirely determined by sensory stimuli, but in many cases the operation of the central factor can still be traced. For example, Parish quotes † from Prof. Lazarus an experience of his own.

* Proceedings of the Society for Psychical Research, vol. x, p. 95. † *Op. cit.*, p. 135.

Prof. Lazarus had been wearying his eyes trying to make out a certain rock on a distant mountain side; as he turned away he saw vividly the corpse of a friend stretched out before him. Upon reflection he found that this friend had been associated with the train of ideas that had filled his mind just before he began to look for the rock. He also found that whenever he closed his eyes he saw a dull, grayish-green, corpselike color, which was the complementary after image of the dull reds, browns, and greens of the mountain side. He also found that other persons of whom he thought appeared to him of the same corpselike tint. In this case the main character of the hallucination—that is, the thought of a friend—was furnished by association of ideas, but its special form, the appearance of that friend as a corpse, as well as its sensory vividness, seems to have been due to the peripheral factor.

A closely analogous experience is reported by a Mrs. L—— in the Proceedings of the Society for Psychical Research, volume x, page 143: "About September, 1881, aged forty-six, and eighteen months after the sudden death of my mother, which had shaken my nerves very much, one night toward morning, being awake to the best of my belief, I saw a woman come through the door. Her face was sideways and I distinctly saw her features. She passed slowly from the door and went out at the window opposite, thus passing across the foot of my bed. She had on an old-fashioned bonnet and an old-fashioned caped coat, and she was carrying a basket in front of her such as country women carry their husbands' dinners in. The whole figure was semi-opaque, neutral-tinted, like thick smoke or cloud. A great hurricane was blowing. I was dreadfully disturbed and hysterical next day—the impression so vivid and yet unable to say who it was. About a week after, the revelation came. I sat down to dinner, became very hysterical and faint, and went into another room alone in the dark. All at once I jumped up, saying, 'It is Mrs. Beasant!' Mrs. Beasant was the pretty young bride of a farmer with whom, when about ten years old, we used to go and take tea at a farm about two or three miles from the vicarage. One day she went with her husband's dinner as usual, and he was felling a tree. She passed the wrong way, and the tree fell on her and killed her. I remember watching her funeral with my nurse, and the anguish of spirit at her death, but never remember speaking of it or the circumstance since. The day before the appearance a nurse of the name of Beasant had disturbed and annoyed me. A few months before a large elm tree had fallen in our garden and partly on the house. A hurricane was blowing at the time, and I remember thinking, 'What a lucky thing that tree can't fall on the roof!'" Clearly the storm, the falling tree, and the annoying nurse were

the chief factors in determining the character of the hallucination, but as they acted through association it is not so clear to what its externalization is to be ascribed. Perhaps the hurlyburly of the storm outside had something to do with it; probably the drowsy, disordinated condition of the percipient favored the formation of the apparition, but of the details of the process one can not speak with confidence.

In the hallucinations of which the crystal vision is the type we have a form intermediate between the true hallucination and the illusion. Prolonged staring into a mirror, a glass of water, a crystal, a piece of glass, or even fixation of the gaze upon a point will induce in some persons brilliantly colored hallucinations. While they are certainly peripherally initiated by the prolonged staring, their special character is nearly always centrally determined—usually, indeed, they simply reproduce old memories. Susceptibility to these hallucinations is by no means uncommon; I have tried about a hundred persons myself, and found that about one in four saw something. Similar hallucinations of hearing can be produced by listening to the "sound of waves" in a large shell, to the sound of water running from a spigot, etc. The stories of ghosts seen in mirrors probably all rest upon this principle. For example:*

"The first hallucination which I was in a position clearly to recognize as such occurred during the Indian mutiny. Several members of our family were in danger. One night on which we had all been talking late of them, after we had parted and gone upstairs to bed, I stood before my dressing table, plaiting my hair, when my attention was arrested by a faint spot in the center of the mirror; this, to my amazement, gradually enlarged (as a grease spot spreads with heat) till the whole surface was covered, and then, in the center of this veil, came through the face of one of the near relatives above mentioned, as plain as might have been his living reflection. I noted the day and hour, and ascertained, six weeks later, that the relative seen had incurred no sort of danger at that date." This misty discoloration of the glass is significant, for many of my subjects describe the glass as becoming milky or cloudy just before the hallucination appears. Occasionally it is possible by means of an indeterminate stimulus of this sort to raise a thought to sensory intensity. Thus Miss X—— saw in the polished surface of a piano a scene of which she was thinking.† I have met with one analogous experience, but it seems to be rare.

Many interesting questions arise as to the relation that exists

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* Proceedings of the Society for Psychical Research, vol. x, p. 407.

† Ibid., vol. v, p. 512.

between the hallucination and the stimulus which has generated it. It is frequently very close, any change in the stimulus either destroying the hallucination or making in it a corresponding change. In the case of crystal gazing, for example, if one looks at the image through a magnifying glass or prism, it is sometimes destroyed and sometimes magnified or doubled. Very often hallucinations originated independently appear to attach themselves in much the same way to some contiguous percept and become practically a part of it. The element to which it is attached is what the French investigators have termed the *point de repère*, and M. Binet has endeavored to show that without such a *point de repère* no hallucination can exist. The matter is still under discussion, and must be set aside with this brief allusion.

If we once admit that subconscious states exist, we are tempted in many cases of hallucination to make use of the conception to explain the facts. In the case of Mrs. Beasant's ghost, for example, it may be that the memory was revived before the apparition was seen, but remained subconscious until externalized by some obscure agencies which one can not precisely specify. An analogous experience—in this case a crystal vision—is given by Miss X——:*

"I find in my notebook a memorandum of August 3d as to a vision of a corner of a room, with a red carpet and walls decorated in stripes of pink, white, and green, for which for many months I was unable to account. Only a few days ago (May 10, 1889, is the date of writing) I called on a friend whom I had not visited since July, and whose house had, I observed, been newly and handsomely decorated. A letter which she had written to me before leaving town in the summer was by chance referred to, and on returning home I sought it, to settle a disputed point, and found that it was dated August 2d and contained the information that her staircase had been painted and 'looked at present like a Neapolitan ice.' This, I doubt not, supplied the coloring of my picture."

Here the development of the vision was influenced by an allusion contained in a letter read the preceding day which was no longer in mind. Now, one must suppose either that that allusion still existed in some way and was capable of influencing the vision, or that the vision had been suggested subconsciously, had existed subconsciously, and had been brought to light by the crystal, or that it had been suggested by the letter, forgotten, and then revived. Of these three suppositions the last is the most plausible, but it is difficult in other cases to resort to it. Take another case of Miss X——'s: "On March 9th I saw in the crystal

* Proceedings of the Society for Psychical Research, vol. v, p. 512.

a rocky coast, a rough sea, an expanse of sand in the foreground. As I watched, the picture was nearly effaced by that of a mouse, so large that I could see only a bit of cliff above his tail. Two days later I was reading a volume of poetry which I remembered having cut open, talking the while, certainly not consciously reading, on the day of my vision. As I turned over the leaves, a couple of lines struck me as somehow familiar, though the book, a volume by Aldrich, was quite new to me:

> Only the sea intoning,
> Only the wainscot mouse.

These, I imagine, suggested the images." Doubtless Miss X——'s eye had fallen on these lines; possibly they aroused some fleeting images in the upper consciousness which were then forgotten. But granting the existence of the subconscious, it is more easy to understand the case upon the supposition that the whole process took place outside the range of her normal consciousness.

A still more striking case of the same author's has been much quoted:

"On March 20th I happened to want the date of Ptolemy Philadelphus, which I could not recall, though feeling sure I knew it, and that I associated it with an event of some importance. When looking in the crystal some hours later, I found a picture of an old man with long, white hair and beard, dressed like a Lyceum Shylock, and busy writing in a large book with tarnished, massive clasps. I wondered much who he was and what he could possibly be doing, and thought it a good opportunity of carrying out a suggestion which had been made to me of examining objects in the crystal with a magnifying glass. The glass revealed to me that my old gentleman was writing in Greek, though the lines faded away as I looked, all but the characters he had last traced—the Latin numerals LXX. Then it flashed into my mind that he was one of the Jewish elders at work on the Septuagint, and that its date, 277 B. C., would serve equally well for Ptolemy Philadelphus. It may be worth while to add, though the fact was not in my conscious memory at the moment, that I had once learned a chronology on a mnemonic system which substituted letters for figures, and that the *memoria technica* for this date was, 'Now Jewish elders indite a Greek copy.'"

If this strange vision had ever been suggested to Miss X—— before by her mnemonic line, why did she not recognize it? And if it had not been suggested before, either it had been suggested in her subconsciousness or else it was suggested to her upper consciousness by a subconscious memory of the mnemonic line.

Another of Miss X——'s visions * is almost precisely similar to that of the sea and the mouse, save that it is still more difficult to suppose that she had any conscious knowledge of that which was revived in the crystal: "It was suggested to me, one day last September, that I should look into the crystal with the intention of seeing *words*, which had at that time formed no part of my experience. I was immediately rewarded by the sight of what was obviously a newspaper announcement in the type familiar to all who read the first column of the Times. It reported the death of a lady, at one time a very frequent visitor in my circle and very intimate with some of my nearest friends, an announcement, therefore, which, had I consciously seen it, would have interested me considerably. I related my vision at breakfast, quoting name, date, place, and an allusion to 'a long period of suffering' borne by the deceased lady, and added that I was sure that I had not heard any report of her illness, or even, for some months, any mention of her likely to suggest such an hallucination. I was, however, aware that I had the day before taken up the first sheet of the Times, but was interrupted before I had consciously read any announcement of death. Mrs. Henry Sidgwick, with whom I was staying, immediately sought for the paper, where we discovered the paragraph almost exactly as I had seen it." If Miss X—— had consciously seen this notice, how came she to forget it?

Cases of this kind strongly suggest, I think, what Mr. Gurney calls "an underground psychosis," but they do not demonstrate its existence; and, unfortunately, most of the cases which would seem to require the assumption of subconscious states also require the still more revolutionary assumption of such powers as telepathy and clairvoyance, which lie outside my present scheme of topics.

All these forms of hallucination are known as sensory automatism, and in my last paper I sketched the conception which underlies the term. I there also alluded to ideal automatism, and with a few words upon that point I must let the subject go.

Our thought trains usually belong to well-defined types, are of a certain average grade of development, and behave in pretty definite ways. For example, they are for the most part subservient to our will, and come and go at our bidding. But sometimes the orderly process of thought is broken up; new classes of ideas obtrude themselves, familiar types rise to a higher level without becoming full-fledged hallucinations, and, last but not least, the will finds itself unable to control them. Such disorders of ideation are often termed ideal automatism. As a very large

* *Op. cit.*, p. 508.

part of our thinking is carried on in ideas of spoken words, a very common form of ideal automatism is the inner voice. A portion of the patient's word ideas rise to a higher level than usual, resist his will, and often say things which strike him as strange and foreign to his own acknowledged thoughts. For the sake of completeness I must refer to this type of automatism, although space forbids me to discuss it in detail.

SOCIAL INSECTS.

By L. N. BADENOCH.

IT is well known that some bees are social and form nests where their broods are reared, workers existing who provide daily for the young. In architectural skill these social kinds do not always hold a foremost place. The cells composing their nests vary in shape from the perfectly hexagonal, as in the hive, to those which are less regularly six-sided, until in the bumblebees' homes they are not in the least like the delicate, sharply defined structures of the true honeybee, but are oval and isolated or distributed almost at random.

Leaving the hive bee out of the question, the bumbles (*Bombi*) alone construct social communities in England; they constitute the nearest ally, as regards its habits, of the true honeybee in North America, which is especially rich in species. Their economy is simple; their colonies begin, enlarge, and end like wasps. They live for one season, perishing with the cold of autumn, except a few queens, which hide themselves away in utter solitude in sheltered and convenient spots, and, awaking with the warmth of spring, lay the foundation of a new swarm. In the ordinary course of things these queens do not survive a second winter.

Parasitic bees (*Apathus*) so closely resemble the bumbles that it requires long practice to distinguish them easily. Little is known of the parasite, other than that it is found in the nests of its hosts, at whose expense it apparently lives, after the manner of the cuckoo. It has no pollen basket, showing that it can not collect food, and its young must feed upon the stores of their hosts, and its jaws seem unadapted for building. Flies and several beetles also prey upon the bees, and the larvæ of moths consume their honey and waxen cells.

In the tropics the honeybee is replaced by the *Meliponæ* and *Trigonæ*, which are generally minute and almost stingless, and live in vast colonies. The former construct a comb for their young, resembling that of the hive, but of one layer of cells, while the honey cells are irregular and occasionally attain a great

size. They nest in hollow trees or in banks or any suitable crevice; the *Trigonæ* suspend pear-shaped combs from the extremities of the branches of trees, without any kind of external covering. *Meliponæ* are masons and prone to block up the gap in the tree they employ with clay, leaving a small orifice for entrance and exit; some stop theirs with wax, and they incline to feed on the sweet sap that exudes from the forest trees and on the excrement of birds rather than on flowers.

FIG. 1.—NEST OF POLISTES. A wasp's nest without cover.

As with the communities of social bees, so with the social wasps (*Vespidæ*), there appears a third order of beings, the workers or neuters, which, like the females, are provided with a sting. The interest attached to the economy of the family rivals that of the wonderful works of the hive; indeed, many of the structures of the social wasps constitute the most beautiful examples of insect architecture. Among them there is a variety of form, an evidence of intelligent choice of the materials used in their construction, a difference of texture produced, and an adaptation of the nest to the circumstances of the situation to which the buildings of the bee can lay no claim. If the hive bee is the more admirable architect, it is decidedly not the most ingenious. It is the better mathematician, but the less facile engineer; it is the more learned, but the less imaginative. While the bees may be said to build in wax, the social wasps are chiefly natural paper or cardboard makers—not out of rags, but ligneous materials, triturated and agglutinated in various ways. Though the nests are upon many plans, essentially they are all alike. Similar cells, nearly always hexagonal, are agglomerated, leaving between them no space to form combs, after the manner of bees, but of very varying aspects. These are the cradles of the larvæ, which, deposited here as eggs, are reared by the female or workers, and,

having attained full growth, they inclose themselves within the cups, with silky convex caps, until their transformation to perfect wasps.

So far as the disposition of the social wasp is concerned, it is a case of being given a bad name, and—well, maltreated. But a wasp seldom attacks when unmolested; yet threaten its citadel, and you will probably have cause to repent, for, with courage that we all must admire, it boldly and persistently resents intrusion on its dwelling and defends against disturbance its helpless young brood.

It combines the most opposed instincts of diet, and is an omnivorous feeder. From the first days of spring till autumn ends, we may see wasps (*Vespa*) intent upon stealing the sweet vegetable liquor they love; in spring they profit by the blossoms of fruit trees. As the fair profusion of summer changes to the soberer autumn wealth, they are presented with another fertile source of nutriment, and it is then their colonies immensely increase. They fall upon fruits voraciously, the choicest and most ripe, and so have gained for themselves a worse reputation than insects much more injurious. Should the season be warm and the increase of their colonies commensurate with the warmth, as it often is, they become a veritable plague, not only in gardens, but at table they agitate us while they nibble at some luscious dish.

Fig. 2.—Home of Myrapetra scutellaris.

But, hateful marauder though the wasp is in these respects, it is a predaceous as well as a vegetable eater, and thus not devoid of the compensating quality of usefulness in ridding us of many a fly and other pests. The audacity with which it seizes and devours insects is astonishing. The attack is sudden: it will spy a fly on the leaf of a bush, and in the twinkling of an eye is upon it; if large, it is dismembered; head, wings, and legs are torn off, and the trunk is

demolished on the spot or borne away. Wasps often attack butterflies of different kinds; pouncing upon the luckless victims, as a falcon on a bird, they drag them to the ground and mutilate them, and subsequently the mangled body seems to be robbed of all vitality ere the wasp takes its final departure with it to the nest. Curiously, if it misses its aim, it does not strike a second time, but flies on, as if to cover its defeat. Immoderately fond of honey, it frequents the vicinity of beehives, ready to swoop on the bees returning home charged with their hard-got spoil.

Social wasps have two principal modes of nidification. Either the combs are enveloped in a covering of simple leaves of generally slender paper, analogous to that which serves for the cells; or the covering is of cardboard, composed of only one layer of material, of a consistence at times extraordinarily thick and resisting, at others slight and supple.

The common paper-makers build in the open air, on trees or bushes, under the roofs of outbuildings, on a beam, or in some such situation; the construction corresponds with that of the ground wasps, but the texture of the foliaceous envelope, which is fabricated with perfect art, has all the appearance of shell-work. It incloses an infinity of cells arranged in many tiers. A nest is invariably built from above downward. The start is made by accumulating on the determined site a good supply of paper, forming it into an umbrellalike canopy. To the under side of this cap—the ceiling, so to speak—the first comb is attached, and the rest of the work consists in prolonging the canopy more or less in an egg-shape, and in establishing additional combs, free, as a rule, only pendent to columns of paper, which pass from the upper surface of each comb to the comb immediately above; entrance is obtained at the lower end. Toward the summit of the envelope is a thickened cellular mass, but this portion excepted, it is made up of a number of separate leaves or layers of paper, limited in size and imbricated, and in contact together merely at the points of imbrication, leaving large cellular spaces between the sheets; moreover, the points of fusion of two successive sheets never fall one over the other. Each sheet therefore lies on a stratum of air, with the result that the exterior layers may be soaked with rain without soiling in the least the ones beneath. Tree wasps increase the size of the combs by cutting away the inner layers of the envelope, taking care to add layers externally so as to maintain, and even to slightly augment, the thickness of the walls, in proportion to the greater magnitude now assumed by the edifice.

Some elegant and graceful pensile nests, although diverse in form, have this in common, that the combs are always destitute of any envelope; and the cell-group is supported by a stalk of paper,

which may be central or wholly lateral. Usually a varnish is rubbed on the cells to prevent them being wetted by rain (Fig. 1).

The envelope of a typical cardboard-maker (*Chartergus chartarius*) is of a veritable cardboard, white, gray, yellow, or buff in color, smooth and solid, and impervious to the weather. It may be conical, cylindrical, almost globe-shaped, straight, but more often is a little curved. In the interior the platforms of cells differ from those of the common paper-making wasp in stretching right across like so many floors, being fastened on all sides to the walls. A simple hole perforates each, enabling the wasps to get from story to story. The form arises from the mode of enlargement of the dwelling. When the number of inhabitants becomes great and a fresh series of cells is required, these wasps do not, as a preliminary proceeding, amplify the envelope so as to extend the tiers; they first build cells, and cover them afterward. Beginning with the bottom of the nest, they set cells upon it, then lengthen the outer wall so as to include this fresh stage, and close in the end with a new floor, in its turn to become the ceiling of the next tier of cells when enlargement is again desired. No trace of the addition is suffered to remain and mar the covering, which would seem constructed at one stroke. Probably these wasps, like *Myrapetra scutellaris* (see Fig. 2), deviate from the ordinary habits of wasps in being collectors of honey.

It would be difficult to find a more peculiar nest than that of *Myrapetra scutellaris*. It is huge as compared with the insects, its brown cardboard wonderfully thick, hard, firm, and coarse in texture, and composed, not of wood fibers, but of the dung of the *capincha*, an aquatic cavy. The strange, fairly conical knobs that beset the surface of the envelope may defend the abode, which hangs low, against mammalia, such as tigers, jaguars, and cougars, that would plunder it of its honey; they appear to protect and conceal the entrance ways—of which, opposed to the custom of wasps, there are many—but they may be simple freaks of Nature. It seems odd for beings so sensible to put these projections on the end of the nest, no less than on the sides, necessitating their gnawing them away each time they add a stage; but probably they possess some means of softening the cardboard, and doubtless the same material, worked up afresh, helps to establish the new tier and the new cells.

IT is represented in a bulletin of the Department of Agriculture that about two hundred and fifty thousand cocoanut palm trees of all ages are growing on the eastern coast of Florida, about twenty-five thousand of which are bearing. The tree is fruitful near the salt water, but does not thrive when removed inland. It begins to fruit in from five to seven years after planting the nut.

THE POTTER'S ART AMONG NATIVE AMERICANS.

By ALICE D. LE PLONGEON.

OF all the arts at which man has labored, that of molding clay was probably the first, the most primitive. It has been practiced in all parts of the world, and the thousands of specimens yet existing are an aid to archæological studies, particularly when found intact and unblemished. It is never easy to decide on the age of any piece, as this is not necessarily indicated by its appearance, least of all in places where, as in Mexico and Peru, cunning artificers manufacture antiquities, making jars a few weeks old appear like the time-begrimed handiwork of their great—very great—grandfather or mother; for women have been and are active in that branch of industry. The Mandan women were clever potters. The Zuñi and the Maya women also do much of that work. A new-looking, well-preserved vase may be a rare antique, while a roughly finished primitive one may be modern or of comparatively recent date. There are scholars who claim that some of the Central American and Peruvian specimens are thousands of years old.

In several parts of America it was customary to place various receptacles in tombs, close by the human remains, some jars being usually filled with food and liquid. The pottery found on the Atlantic coast is poor and not abundant, but there is a great quantity in the western part of the United States, as well as in Mexico, Central America, and Peru. Colorado, Missouri, and Ohio are States which have yielded very large collections, varying from crude work to some that is admirable, a certain similarity existing in all. The Alaskan productions are considered of a better quality, in paste and in baking, than any other on the American continent. Some of the large Alaskan vases were coated with a grayish-white wash, and polished after the manner of Phœnician wares. They were decorated with bold devices in black and dark red.

The North Americans modeled their utensils by hand, without wheel, and none seem to have understood the art of glazing. They mixed their clay with pounded shells, with sand, or with pulverized siliceous rock; mica was also used. After being shaped, the clay was hardened in open fires or kilns. Among the many ornamentations, that imitating basket work was much used, and may have suggested itself because the modeling was sometimes done inside of baskets. Similar devices are common on ancient German pottery. The Greek ornament ( ) was very common in America, while Phœnician art is suggested by some of the life forms seen on the Peruvian and Chiriquian

pottery. In the Peruvian most of the care bestowed on the decorations was given to the faces of the creatures represented, the rest of the body being fashioned without any apparent attempt to faithfully imitate Nature. Some pieces found in ancient tombs resemble Etrurian or Etruscan work of the same class. The potters did their best work on jars that were to be deposited in sepulchres. Articles for domestic service were of the simplest description. The materials used for the funereal vessels, called *huacas* and *canopas*, were light-colored clay and a blackish sort of earth mixed and worked in such a way as not to absorb liquid. The secret of that method is lost to us. Some of the finest productions appear to have been submitted to the action of fire, but the majority have evidently been hardened only by the heat of the sun.

FIG. 1.

A long, slim neck is a distinguishing feature of much of the Peruvian pottery; and nearly every vessel is ornamented with a figure of some sort, having holes to represent eyes and other openings. These afford a passage for the air forced out by the liquid when poured into the vessel. By an ingenious contrivance the air in escaping produces a sound similar to the cry of the creature represented. Thus a utensil decorated with two monkeys embracing each other, on having water poured into or from it, would give a sound like the screeching of those animals. One decorated with a bird would emit birdlike notes; while a mountain cat on one jar would mew, snakes coiled around another would hiss. The most curious that we have seen was the figure of an aged woman. When the jar was in use her sobs became audible, and tears trickled down her cheeks. The manufacturers seemed to have known all about atmospheric pressure. Dr. Le Plongeon had in his own collection a piece that demonstrated this. It represented a double-headed bird. The vessel had to be filled through a hole in the bottom,

and yet in turning it over not a drop would spill, but the liquid would readily flow out when the jar was simply inclined. The Peruvians were good portraitists, and many of the faces represented might pass for likenesses of people now living on the coast. The potter of the present day uses a primitive contri-

FIG. 2.

vance, something like two tables fastened together and revolving on an axis firmly fixed in the ground. The lower table serves as a treadle by which the workman imparts a rotary motion with his naked feet to the whole contrivance. On the upper table, the smaller of the two, is placed the moist clay which the potter shapes to his fancy.

The pots found in tombs are made of various kinds of clay—red, yellow, brown, bluish, and black. The latter is generally only modeled, the red being modeled and painted. None are glazed. Many of the Peruvian jars are double, quadruple, sextuple, even octuple. The pottery of the Antis is believed to be of Quichua (Peruvian) origin. It is coarsely made, painted and varnished. From the cannibal Conibos they obtain, through the Chontaquiros, more elegant ware.

The illustrations (Figs. 1, 2, and 3) represent pieces found by Dr. Le Plongeon on the coast of Peru, all belonging to a period

prior to the Inca civilization; they are from six to ten inches high. The canopa, an upright bottle, in Fig. 3, is very suggestive, its name calling to mind the canopi, or funeral vases used by ancient Egyptians, though the word is of Maya origin, as Dr. Le Plongeon has fully explained in one of his books. Traveling south of Peru, we find that in Chile, near Santiago, the capital, there is a fragrant clay called *buccari*, of fine quality and light weight, its color being brown with yellow spots. The inmates of convents convert this into varions utensils which they paint, gild, and varnish. It is said that water placed in them has an agreeable perfume and flavor. North of Peru, in Ecuador, near Quito the capital, a similar clay is found.

Chiriqui is an interesting field for students of the ceramic art. Politically Chiriqui is a part of South America, while geographically it belongs to the northern continent. It is between Veragua on the east and Costa Rica on the west. Pottery is most abundant in the lands around the bay of David, though found all along that part of the coast. The Chiriquian modeling shows more symmetry of form than any other on the continent. In graves, from three to twenty pieces are usually found. One explorer obtained ten thousand articles of clay from burial places covering an area of fifty square miles. The ware is uniform. The matrix is of fine clay tempered with pulverized sand. Grains of quartz, feldspar, hornblende, iron oxide, etc., can be detected. Argillaceous matter was sparingly used except in outer coatings, the

FIG. 3.

sand in many instances comprising at least seventy-five per cent of the mass.

Some of the work is similar to that in Costa Rica and the Colombian States. The Maypures of Colombia form cylinders of clay, and shape even the largest vases by hand, without any wheel. In Nicaragua, too, clay utensils are formed entirely by

hand. After being baked some pieces were partially glazed, or varnished with a resinous gum, warmed over a bed of coals and gently rubbed over the vessels. The natives on the Amazon employed a similar method.

With clay the Chiriquians made a great variety of objects, including many shaped vessels, drums, whistles, rattles, stools, spindle whorls, needle cases, toys, and other small objects. The baking was effected with a low degree of temperature, and in a way that produced no discoloration. All the work was skillfully done and so neatly finished that the method by which it was accomplished can not be detected. The eye and the hand of the manipulator must have been exquisitely trained.

Complex pieces were made in parts that were cleverly put together, no portion being injured. The heads and other parts of animals, handles, legs, bases of vessels, were luted on with consummate skill, the thinnest walls and most complex delicate forms not being injured in the process. Before the surface wash was applied, the whole was carefully smoothed. After the application, and when the clay was somewhat indurated, smooth pebbles were used to polish the surface. This was sometimes done so thoroughly that the finish has been mistaken for glaze of a vitreous nature. Ornamental painting and intaglio devices were usually done after the polishing. The general colors of the paste were light yellow, gray, ochery yellow, and pale terra-cotta red. Dark brown, salmon, and orange hues are occasionally found. The paints used for decorating were reds, blacks, and purple grays. The red varied from a light vermilion to a deep maroon. The colors are indelible, and are believed to be of a mineral character.

Many jars were manufactured only to be placed with the dead. Tripods are supposed to have served for religious ceremonies as braziers. Most of the fine pieces were made expressly for religious or funeral purposes. The various forms were always symmetrical. Some jars had as many as four mouths.

Among the various ornamental devices are included fish, crabs, frogs, crocodiles, pumas, and monkeys, also a conventional serpent. Too much can not be said in praise of the beauty of outline of these vases, but in any case where the artist has attempted a human figure the result is a deplorable failure. There are a few double-headed vases and an approach to the modeling of jars in animal forms after the Peruvian style.

There are at least ten varieties of painted ware, apparently the work of different communities. Generally speaking, the vessels were not of large dimensions, some elaborately ornamented ones being only four inches high. Even cooking pots were what we should call decidedly small. It is evident that the Chiriquians

were lovers of music, judging by the instruments fashioned from clay. It is hardly likely that the musicians confined themselves to that material in their production of sweet sounds. Terra-cotta drums, rattles, whistles, and flutes have been found. There are rattles shaped like the gourd, which vegetable product seems to have first served man as a rattle. The Mayas of Central America yet use it in certain religious dances. The handles of Chiriquian rattles were made as whistles. The bodies of drums were sometimes made of clay, though these specimens are rare. They were shaped somewhat like an egg-cup, the small part serving as base, the tissue or skin being stretched over the larger orifice.

The wind instruments are capable of yielding very sweet though not powerful or far-reaching tones. The note on any one stop is in some instances susceptible of change by varying the force of the breath, affording much scope to a skillful performer. With

FIG. 4.

FIG. 5.

the exception of the drums the clay instruments are not more than about eight inches long. The whistles were constructed on the same principle as the modern flageolet. They give eight or more notes, though not a true scale. The bird was quite appropriately a favorite shape for whistles, the finger holes or stops being in the breast. On them a practiced performer could imitate the song birds with some accuracy.

In Corozal Island on the east coast of Yucatan, there are vases with flaring rims supported on three short legs, like some of Chiriqui. Our illustrations of Chiriqui pottery are: 4. Vase with four handles—decorations in black, red, and purple. Ten inches high. This form is frequently found in Mexico and Central America. 5. Vase, eight inches high, with hollow base. Elaborate designs in red, white, black, and purple. Equal to Chinese or Egyptian work. 6. A tripod nine inches high. Similar ones have been found in Cozumel Island, having hollow legs, contain-

ing pellets. Notwithstanding the beauty and symmetry of their work, the Chiriquians seem to have lacked one faculty that the people farther north, in Honduras and the Yucatan peninsula, had fully developed; for they failed to portray, even poorly, the human face, while the latter were clever portraitists.

FIG. 6.

In Honduras a wealth of pottery may be dug from the soil; but this must be done with care, otherwise the frail things will inevitably be broken, owing to their moist condition. When exposed to air and sunlight they become hardened and may be handled with less risk.

At Mugeres or Woman's Island (latitude 21° 18′ north and longitude 86° 42′ west, Greenwich meridian)—so called by the Spaniards because they found many statues of women there—an ancient shrine stands on a rocky promontory at the south end of the island. There the waves perpetually dash themselves as if in blind fury. Atom by atom the rocks must yield to the force of perpetual motion; then this old shrine of strong masonry will fall into the maw of Neptune. Long ago thousands of pilgrims used to bring to the spot votive offerings of all kinds. Fragments of pottery are scattered over the ground in front of the building. Delving in the sand, we brought to light a fine incense-burner. Unfortunately, a man, too anxious to help, thrust a spade in the sand and broke the object before we had time to say "Hold!"

Afterward, in one of the fragments, we kindled charcoal to varnish photographs which we had taken. From the heated pottery an exquisite odor was wafted on the air. Thus, once again, and probably for the last time, was the shrine perfumed with the sweet incense which had permeated the porous clay, and truly it was delicious enough to delight not only the most fastidious devotees but the most exacting divinities. The face which had ornamented the burner escaped injury, as did the feet from the lower part of the brazier. Able potters of these modern times have pronounced the face a very fine piece of modeling. It is now in the museum of the Antiquarian Society of Worcester, Mass. The woman represented did not belong to any of the races that followed the customs of deforming their skulls; but she had her front teeth filed in points, a fashion which was in vogue among some Americans as it is among the Fans of equatorial

Africa. This may indicate that the individual depicted on the burner was a Maya. The Mayas never deformed their skulls, and some of them filed their teeth in just this way, as can be seen in the statue called Chaacmol, unearthed by Dr. Le Plongeon. A duplicate of the statue is in the museum at Washington.

About forty miles south of Mugeres Island, and ten from the east coast of Yucatan, is the abiding place of Spring, the lovely island of Cozumel, almost uninhabited now. When the Spaniards arrived there, three hundred and sixty-five years ago, it had a hundred thousand inhabitants, besides an annual concourse of fifty thousand pilgrims that worshiped at its temples. This "place of swallows" (*cuzamil*, hence Cozumel) is an interesting spot for the antiquary. In the dense forests there are curious old buildings, and round about them, beneath the surface of the ground, may be found many a specimen of the ceramic art. Illustration No. 7 shows a fine incense-burner from there, with scarcely a blemish, and similar to the one so unfortunately broken at Mugeres Island. Its ornamentation represents the goddess of the bees. Like the other, this forehead shows no artificial deformity. The clay was of fine quality and in color a rich red brown, while the broken burner was of a light yellowish clay found only on the mainland. After examining hundreds of specimens we are inclined to believe that among those people individuals were given names suggested by some trait in their character or peculiarity of appearance, and that the artists ingeniously indicated such appellations in a headdress or other ornament. In some instances such headgear as this was used in battle.

Fig. 7.

Pottery from Palenque exhibits entirely different features. The two vases here given (Fig. 8) are in the Government House of Balize, British Honduras. Here we see the Palenque type, with artificially deformed forehead. The way in which the hair is curled and banged suggests a very rakish Bacchus, appropriate ornamentation for an antique punch bowl. The Honduranians seem to have been as ingenious as the Peruvians in their terra-cotta works. We have before us two jars which appear to be glazed in imitation of bronze. One is intended to represent an armadillo, the other a familiar domesticated hen that cackles melodiously when the water gushes from her open

beak. This effect is produced by a small pebble cleverly placed in her throat.

Among figures of all shapes and sizes several had holes that did not enhance their appearance and were not in accordance with Nature. A dog, for instance, may be allowed a mouth and two eyes, but why an extra pair of orbs on each side of its small body? Simply that the impertinent-looking pup was a musical instrument, the six eyes corresponding to six sweet and clear flutelike tones—C, D, E, F, G, A. On these clay instruments the native melodies can be played, their compass not exceeding six notes.

In the deep sand at Progreso, port of Yucatan, objects of clay have frequently been found. One in our possession is interesting because of what it represents. The double mouthpiece gives the notes C and D. Blue paint yet remains on the clay (blue was emblematic of sanctity), indicative of the veneration which was attributed to the creature, roughly suggested by the uplifted proboscis. The mastodon, whose visage is depicted everywhere on the walls of Yucatan's ancient cities, was taken by the Mayas as one symbol of the Creator. They made it their god of the ocean, life being first generated in water. Beneath the upturned proboscis there is a mutilated human face surrounded by a broad collar or necklace.

FIG. 8.

The persons who in ages gone by had used the little dog-flute and the double whistle just described were not unfamiliar with the seductive weed, for in applying our lips to them the flavor and odor of tobacco were quite unmistakable. The late General Bogran, when President of Honduras, personally found the clay pup and gave it to us, so that the tobacco was not imparted to it after its discovery.

In the National Museum of Mexico's capital are some ornamental vases, three feet high, which might perhaps justly be regarded as the culmination, the perfection of the ceramic art—they are so very handsome, fine and intricate in form and decoration. But to which of the Mexican tribes the work should be ascribed is a question. In the State of Oaxaca funeral urns have been found inscribed with Maya hieroglyphics which have been interpreted

by Dr. Le Plongeon. Their meaning is "the extinguished," "the snuffed out"; a brief but unquestionable allusion to the deceased.

There is a fascination about antique pottery. In handling a funeral vase, for instance, one can not help indulging in a little imagination about the scenes which occurred when the object was placed in the tomb. Visions of queer figures and fantastic rites flit before our mind's eye till we shake off the waking dreams, breathing a vain wish that the clay might be endowed with the power to tell, not its own story, but of those events which transpired in connection with it.

DUST AND SAND STORMS IN THE WEST.

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FOR some years the writer has been gathering data on the transportation of sand and dust by the atmosphere, with a view of studying the geological significance of these phenomena. Among other sources of information the newspapers have been drawn upon, and it is to the facts gathered from these, and by personal correspondence that it is at present desired to direct attention. The newspaper man may not always state facts with such exactness and precision as would be desirable, but his ubiquity no less than the very conservatism of the scientist, who seeks the broadest possible foundation for all generalizations, combine to give him a function in the investigation of the laws of Nature. Of course, it can be only a humble function—that of an observer who is not always to be trusted. For the lack of training or by reason of other shortcomings his accounts of natural phenomena must sometimes be taken *cum grano salis*. Dust storms occur chiefly over arid lands, and they develop their greatest force mostly only in regions which are but sparsely inhabited, if at all. They are not often witnessed by geologists. As a consequence, they have been but little studied, and it is desirable to collect information from all sources with regard to their nature and occurrence.

While dust storms are sometimes to be seen east of the Mississippi River, they are much more frequent in the arid and semi-arid regions of the western part of the United States, where the rainfall is small. Of the thirty-eight storms found recorded during 1894 and 1895, only one occurred east of the Mississippi. The distribution over the Western States and Territories was as follows:

California	9	Oklahoma	2
Arizona	7	South Dakota	2
Washington	5	Nevada	1
Oregon	3	Montana	1
Colorado	2	Nebraska	1
Kansas	2	Iowa	1
North Dakota	2	Illinois	1

While the number of reported storms is too small to warrant a discussion of their geographical distribution in the United States, the above table so far, no doubt, correctly represents the facts that it shows an increase from the Western plains to the Pacific coast, and comes to a maximum in the Southwest. On the plains most places are reported to experience dust storms two or three times in a year, while on the Pacific coast estimates and records for different places range considerably above this number. At Los Angeles, Cal., one observer says that there are "two or three in the course of a year, possibly a few more." From Yuma, Ariz., the statement comes that "any high wind, without rain, generally blows clouds of dust," and six sand storms were recorded by observer A. Ashenberger in the Weather Bureau station at that place during 1893. At Ontario, Cal., it is estimated that there are from twelve to forty dust storms in a year. It is said that these storms are "most common and strongest in passes in the mountain ranges in California," that they are "very severe on the east side of the Coast Range," and that "nearly every part of California is afflicted [by them] at times." From the reports which are at hand an estimate of the minimum frequency of these disturbances in places in the West, where topographical and climatal conditions do not forbid them, is two in a year for the territory east of the Rocky Mountains and five in a year for the Great Basin and the western slope. A maximum estimate would be four annually for the former region and twenty for the latter.

Data on the areal extent of each separate storm are meager, as reports of simultaneous observations have been secured in but few instances. Where such observations have been reported they represent, as is evident, the minimum extent of the storm in one direction, since it may have extended beyond the points from which the reports have come. The few instances of reported areal extent of dust storms may be tabulated as follows:

Areal Extent of Single Storms.

From Milton, Ore., to Colfax, Wash.	80 miles.
" Fresno, Cal., to Santa Maria, Cal	120 "
" Mojave, Cal., to Oceanside, Cal	140 "
" Salem, S. Dak., to Sanborn, N. Dak	216 "
" Santa Anna, Cal., to San Diego, Cal	270 "
"Over the greater part of Nevada"	500 "
Over most of northern Iowa and Illinois	400 "

This gives an average diameter of two hundred and sixteen miles.

Information has also been sought with regard to the length of time that these storms continue to blow at any one place. In several instances the reports state this time, and in these cases it varies from one to forty-two hours, and averages a little over thirteen hours, as may be seen below:

Duration of Dust Storms.

2 storms lasted for	1 hour.
2 " " "	2 hours.
1 storm " "	4 "
2 storms " "	6 "
2 " " "	8 "
2 " " "	12 "
1 storm " "	16 "
1 " " "	18 "
2 storms " "	24 "
2 " " "	30 "
1 storm " "	42 "

Supplementing these direct observations, estimates have been obtained from a few parties, and these make the time considerably longer. These estimates are as follows: "Sometimes an hour, sometimes three days, coming with great violence at intervals." (One hour, seventy-two hours.)—"We have known one that continued a week, with one day for a recess."—"The sand storms last from one day to three days, but sometimes only a few hours." (Four hours, twenty-four hours, seventy-two hours.)—"The sand storms last about one day." (Twenty-four hours.)

Leaving out the storm that lasted six days, thirty-two hours would appear to be a fair average for the other estimates. But these estimates perhaps apply more particularly to the greatest storms, while the previous table no doubt includes a rather large proportion of short, tornadolike winds. A mean of the averages is not far from twenty-four hours, and this is perhaps a safer estimate of the average time of a single dust storm. These atmospheric disturbances occur on the steeper gradients of areas of low barometric pressure, and they partake of the progressive eastward motion of these. Their duration at any particular point will hence depend upon their areal extent and upon the velocity of the low area. If the diameter of the dust storm be divided by the time, we will have this velocity, which in this case will be less than ten miles an hour. This is less than half the usual rate of eastward progress of a low area in the eastern part of the United States, but it corresponds more nearly with the rate observed in the Great Basin, where most of these storms occurred.

In nearly every instance where these disturbances have been described some mention is made of the quantity of the material transported by the atmosphere. Nevertheless, it is exceedingly difficult to make any definite estimate in this direction, as no actual measurements have been made by any of the observers. But a number of the accounts are such that comparisons can be made between the phenomena described and some other instances of dust transportation which have come to the writer's notice, and which have furnished some quantitative estimates. The results of such comparisons are here given for what they are worth. In several cases the effect of the dust on the transparency of the atmosphere is noted. It is thus stated that—"It gives the sun a sickly color."—"It is dense enough to obscure the mountain ranges from view" (at a distance of from five to ten miles).—"It is sufficient to allow the sun being viewed with the naked eye."—"Immense quantities of sand and dust filled the air, until the sun became so obscure that it could only be seen as a round ball, at which one could gaze with impunity."

During a high wind on the 25th of March, 1895, following a dry season, the atmosphere over the northern part of Illinois and over a part of Iowa had an appearance which corresponded to the instances here described. The storm lasted about three hours, and during that time an apparatus for collecting dust from the atmosphere was suspended at an elevation of about a hundred feet above the ground back of the bluffs of the Mississippi River at Rock Island, Ill. This apparatus was so arranged that dust could not be taken from a current of air more than a tenth of a square foot in cross-section. It is possible that the actual current was not more than a tenth as large as this. The quantity of dust collected was about two ounces. The wind velocity for the three hours was thirty miles per hour. This indicates that the atmosphere on that day carried a load of one hundred and sixty, or possibly sixteen hundred, tons of dust to the cubic mile of air.

Some of the notes refer to the accumulation of dust and sand in dwelling houses and other buildings, viz.: "Merchants closed their doors to protect their goods" (from the dust).—"The quantity of sand swept from houses (by housekeepers after a storm) showed the severity of the storm the two previous days. The sand penetrated every nook and corner."—"The pattern of the carpet may be obliterated; drifts have been formed on the floor from one to two inches in depth."—"The dust filled every residence completely [!] covering up everything while it lasted."—"The wind hurled a few quarter sections [!] of rich loam into the residences and business houses."

Blown dust is a general and familiar nuisance to housekeepers over the entire West. A minimum estimate, verified by direct

observation, for the quantity of dust settling on floors during such storms is about a fourteenth of an ounce of dust on a surface of a square yard in half a day. A maximum estimate made on the basis of the above newspaper accounts would be at least five pounds to a square yard of surface for a storm lasting twenty-four hours. If we then suppose that a house that is twenty-four feet wide and thirty-two feet long has open crevices, which average a sixteenth of an inch in width and have a running length in windows and doors of one hundred and fifty feet, the wind may be supposed to enter half of these crevices with a velocity of five miles per hour for the time the storm lasts, or for twenty-four hours. The dust may be supposed to settle on not less than eighty-five square yards of surface, including floor space and horizontal surfaces of furniture. The minimum estimate, based on these figures, gives us two hundred and twenty-five tons of dust to the cubic mile of air. The maximum estimate would be one hundred and twenty-six thousand tons.

In the following citations the optical aspects of the dust-laden air are again characterized in a definite way: "The air was so full of sand that it resembled a fog."—"A wind storm struck us, bringing a dense cloud of dust."—"The sky assumed a deep, tawny hue, and fifty yards was the limit of clear vision."—"The dust was so thick and heavy that a person could not see more than a block through it."—"The dust was so thick that it was impossible to see halfway across the street."—"I have seen the dust so fill the air [in a Western dust storm] as to make it difficult to see more than a few rods."—"At times it was impossible to see across the street on account of the flying sand."—"A strong wind was made thick and yellow by flying real estate."—"The wind filled the air with dust as far as the eye could see. It immediately became dark, and lamps had to be lighted."—"During the sand storm it was dark as night, and people ran into each other in their flight through the streets."—"The wind was accompanied by dense clouds of dust that obscured the sky until all was dark as midnight."

From the phrases used it is evident that the transparency of the atmosphere must have been considerably less than when the sun could be viewed through it, or when objects might be seen dimly at a distance of one or two miles, as in some instances previously mentioned. This difference in the two cases is, of course, due to the increased quantity of dust carried by the air. Such conditions as are described here may readily be produced experimentally on a small scale by throwing dust into the air on a windy day. If the quantity of the dust be known, it is necessary only to estimate the degree of opacity produced and the bulk of the air in which the material is dispersed. From a number of

experiments, it appears that two ounces of dust suspended in about four thousand cubic feet of air render it as thick as it must have been, at the least, in the storms described. This would make about two thousand tons to a cubic mile. It should be added that these experiments were made in a wind moving about eight miles an hour, and with dust quite fine enough to be suspended in such a wind. A considerably larger quantity would no doubt be required if the material were to be coarser, such as would be carried by a strong wind. The estimate is therefore believed to represent a minimum for such storms as are described above.

Another perhaps less reliable estimate may be made from accounts which describe the drifting sand, thus: "The sand drifts, as snow does, and has attained such a depth as to cause a fear that vegetation in the simoom's path will be greatly damaged."—"Drifts of sand one foot high were piled up in thirty minutes on a railroad track."—"Cuts [along a railroad] were filled with immense drifts, which averaged about two thirds sand and one third snow."—"At Cheyenne Wells, Colorado, thirteen cars of sand were taken from the depot platform" (after a storm).—"Tracks were obliterated [by drifting sand] and the whole landscape was changed."

Under such conditions it may be surmised that a drift of twenty-five tons of sand might be deposited during six hours from a current of air forty feet wide from the lowest ten feet, in the lee of some intercepting obstacle, as in a railroad cut. In fact, such instances are on record. The velocity so near the ground would not exceed fifty miles an hour. Twenty-five tons may therefore be carried by 633,600,000 cubic feet of air, which makes nearly six thousand tons to a cubic mile. It is by no means likely that all, or even the greater part, of the sand carried by the lowest ten feet of the atmosphere can be left in the drift, and the estimate may again be much too low.

Still another approximation can be made by experimenting on the effects of dust in the atmosphere on the respiratory mechanism of the human body. Such effects are referred to in the following paragraphs:

"The wind sweeps down from the deserts and brings with it sand in such quantities as to almost make breathing impossible."—"The sand was blown in stifling clouds about them."—"During the sand storm the air is so full of dust that it feels as if it were impossible to breathe."

By some simple experiments it has been ascertained that less than two grains of mineral dust suspended in a cubic foot of air interferes with inhalation in a normal way. This would make about twenty thousand tons of dust to the cubic mile. It is pos-

sible that the stifling sensations felt in a dust-laden atmosphere are the results of a cumulative stimulus on the nervous system, and a smaller quantity might produce similar effects. No doubt there is also a subjective factor which will modify estimates on this line.

Lastly, an estimate, or rather a measurement, has been made on the quantity of sand carried in such storms as are recounted in the following items: "The sand is blown about in such quantities that it is not possible to keep one's eyes open."—"A man venturing into a whirlwind of sand invariably returned in a few minutes with his face bleeding with hundreds of cuts."—"Clouds of sand were driven through the air by a high wind, obscuring all objects and rendering existence almost impossible (*sic*) for man and beast."

In 1886 the writer had the opportunity to be in the midst of such flying sand on the Western plains, and to make some observations on the quantity borne by the air. The storm was not as severe as those described in the above paragraphs, nor did it carry as much drift, for neither was the author's facial integument punctured nor did he experience any apprehensions as to the possibility of continued existence. But there was enough of sand in the air to deposit one ninth of an ounce during fifteen minutes in a vial with an aperture measuring one tenth of a square inch turned to the windward. A velocity of twenty miles per hour was probably not exceeded where the receptacle was placed, and this would make the load carried equal to nearly thirty thousand tons per cubic mile.

To sum up: The estimated loads of sand and dust that may be carried by the atmosphere range from 150 to 126,000 tons per cubic mile of air, or from 0·0009 to 0·77 grammes per cubic foot.

Summary of Estimates.

	No. of tons per cubic mile.	No. of grammes per cubic foot.	No. of grammes per cubic metre.
Estimate on a thick haze	160	0·0009	0·031
Lowest estimate from accumulation in dwellings	225	0·0013	0·048
Estimate on opaque dust clouds	2,000	0·012	0·434
Estimate on forming sand drifts	6,000	0·037	1·30
Estimate from effect of dust in the air on breathing	20,000	0·123	4·34
Estimate from a quantity of sand collected in a storm	30,000	0·184	6·49
Highest estimate from a quantity of sand in dwellings	126,000	0·77	27·29

With these figures and the data on the duration and on the frequency of sand storms in the western part of the United States, it seems possible to form some idea of the total amount of work performed by such storms over this territory. It is not believed that the data presented justify any great claims for exactness

for a general estimate, which is made here in the absence of a better one.

If we say that this western country experiences a dust storm twice a year, we do not rate this work too high. During two such days the velocity of the wind for the lowest mile in the atmosphere will average, at least, thirty miles an hour, and the total wind movement will be 1,440 miles. Of course, there are many sheltered places where such winds will not be felt. The territory including the west two thirds of the Dakotas, of Nebraska, Kansas, Oklahoma, and Texas, and extending west to the Pacific Ocean, contains about 1,000,000 square miles of open land, allowing one third the area for mountains. For the time of the storm the atmosphere over this area may be regarded as a current of air 1,000 miles long, 1,000 miles wide, and a mile high, containing 1,000,000 cubic miles of air. If the lowest 200 feet in this current carry a load of 20,000 tons to the cubic mile, and if the remaining 5,080 feet carry 100 tons per cubic mile, there will be 853 tons of dust to each square mile of the whole area of the current, making a total of 853,700,000 tons transported a distance of 1,440 miles, or, if the expression be permitted, 1,229,342,400,000 *mile-tons* of transportation will be performed.

Comparing this with the quantity of work performed by the water of the Mississippi drainage system, we find that the latter is three hundred and thirty times as great. The Mississippi carries annually 406,250,000,000 tons (estimate by Humphrey and Abbott) of sediments a distance of, say, 1,000 miles, performing 406,250,000,000,000 *mile-tons* of transportation. The ratio of the atmospheric transportation in the West and the aqueous transportation in the Mississippi basin is then 1 : 330.

If the above estimates have any significance at all, it is to the effect that in this country the work of the atmosphere is less than the work performed by meteoric waters. So far the inference is in full accord with the well-grounded general consensus among geologists.

Care has been used to not overrate any of the factors entering into the estimates. In sandy regions a considerable amount of transportation is effected by pushing by the wind on the loose surface material. This part of the work of the wind is here entirely neglected. It is known, too, that even on calm days the atmosphere carries an appreciable load of dust, and this has not been taken into account, though it operates for the remaining three hundred and sixty-three days of the year. It is, therefore, possible that the general estimate is too low. But it is not necessary to have recourse to such a supposition alone to show that, locally, work by the atmosphere may exceed the work performed by the water. The observed average wind velocities in these

storms appear to be about twenty-five miles an hour. Velocities two and a half times as high as this are not unknown, and the efficiency of such a current is two hundred and five times that of one having a velocity of twenty-five miles an hour. If the velocity is doubled it increases the transporting power sixty-four times. Should such storms then occur on twenty days of the year instead of on two, the total work would be six hundred and forty times more effective than in the first instance. Still another increase would result from the greater vertical dispersion of the lower greater load in a wind with high velocity. A predominance of aërial transportation may, of course, also be due to local inefficiency of the aqueous work. But this digression is not made for the purpose of proving the possibility of such a predominance in any place. A proof of this would be superfluous, since the topography of sand-hill regions is conclusive evidence on this point. It is merely desired to emphasize the fact that atmospheric work is subject to very great range in its effectiveness, and that as a consequence the great range of the estimates made above does not impeach their trustworthiness.

Some other stray items of information, culled from the newspaper accounts, may be briefly stated in closing. The only statement from which the distance over which dust has been transported can be definitely estimated is in a notice coming from the southern part of California. From the notice made it is certain that dust must have been carried twenty miles. Of course, this does not speak against the possibility of a transportation over twenty times that distance. In one case a slow settling of fine dust from the air is reported as actually observed, and this was also in California. The maximum wind velocities reported in connection with dust storms are few, running from 36 to 90 miles per hour, viz.: 36, 40, 45, 50–60, 90. Some instances of the erosive effects of blown sand are described. It is stated that winds will raise dust on sparsely covered, not cultivated land; that orange trees in California are sometimes girdled near the ground by sand blasts; that the glass in the windows of railroad coaches is etched by impinging sand; and that paint on the coaches is worn off in the same way. The softer wood in telegraph poles is sometimes worn away by sand so much faster than the harder wood in the knots that the latter are left protruding far out. Finally, there are some accounts of the coarseness of the transported material. It is generally fine enough to be called dust, but sand is often mingled with the dust, and occasionally there is fine gravel. Two reports mention pebbles, and in one instance these are said to have been large enough to "knock a man senseless."

To the writer the facts here presented appear most interesting in their incompleteness. While there are tens of thousands of

square miles in the West where the wind has covered the land with monuments of its undisputed reign, the ever-changing sand hills, very little is known as to the quantity of the work performed by the wind in such regions, or as to the relation between this work and prevailing wind velocities. It is evident, also, that a considerable quantity of fine *débris* is removed by the wind in such places, but observations are wanting as to what becomes of this product of trituration after it is raised from the creeping sand, how far it is carried, or where it is deposited. The atmosphere is known to carry appreciable quantities of dust, as already stated, even in low winds, but on this work the study of the dust storms and sand storms has no bearing. The study of the geological work of the atmosphere evidently requires a wider basis of facts.

THE "NEW WOMAN" AND HER DEBTS.

By CLARE DE GRAFFENRIED.

WE delight to glorify the "new woman," the advanced woman. If, however, we study Prof. Otis T. Mason's book, Woman's Share in Primitive Culture, we find the "new woman" to be only a revival of a very ancient type. Prof. Mason says that, for the highest ideals of civilization, in humanitarianism, education, and government, the way was prepared in savagery by mothers and the female clan groups. While men were the inventors of every murderous art, women were the actual inventors of the peaceful arts, and excelled in weaving, pottery, agriculture, the preparation of foods, and the substitution of other forces to do the work of the human muscles. Woman made rough looms. She tamed the present domestic animals. The first empirical physicians were not the sorcerers but the herb women, who collected also the earliest *materia medica*. Savage woman founded all the modern crafts. She was the butcher, the cook and server, the skin curer and dresser, the furrier, tailor, carver, cobbler, the hat and dress maker. She it was who made possible the great modern textile industries. In weaving, dyeing, embroidery, molding, modeling, and painting, in the origination first of geometric patterns and then of free-hand drawing, primitive women elaborated æsthetic art. They were also the earliest linguists, the founders of society as distinguished from savagery, the home-makers, and the patrons of religion.

Undeniably in those days woman was emancipated. In ancient civilizations her industrial skill was astonishing, as among the Egyptians, where, too, her legal and political rights were carefully guarded. But as clan groups made way for larger political

units, as man was less busy conquering and enslaving enemies, he began to enslave his helpmeet, confining her within narrower social bounds, withdrawing from her all share and voice in public affairs, establishing, in short, a social order now known as Orientalism, to some extent characteristic of the Jews through the Persians, and fastened anew on Christianity by the Oriental St. Paul, who preached the subjection of woman. With the decadence of Greece and Rome, woman fell from her high estate of honored equality, and in the dark ages as a social factor she disappeared.

Nevertheless, she was the worker, though receiving no credit for her work. Under the feudal system, when men were bound to bear arms and make constant war, women carried on the trades and arts around the baronial castles, in the wretched homes of the serfs—but not as free agents, only as chattels of their husbands. Later, in the middle ages, all the great industries were controlled by guilds and syndics, which regulated the manufacture and sale of goods, but in which man only represented the working classes. He alone had power, he alone drew wages. Though the exquisite silks, damasks, and embroideries that were the fruit of his loom embodied a dozen kinds of skilled labor performed by his wife and daughters—hackling, combing, carding, dressing, spinning, dyeing, weaving—only the head of the household counted and handled the pay.

Everywhere in Europe and America, before the era of steam machinery, women plied the industrial crafts at home, in towns, in villages, in the country. The conditions under which these domestic industries were carried on were bad, indeed, almost intolerable —in damp, overcrowded habitations, without air or drainage, amid squalor, want, filth, and devastating epidemics. But woman, the most important agent in such productive labor, was economically and politically ignored. She had no power, no voice, no pay; and without money she had no control of her own time or her own aptitudes. In fact, she was very like a slave; and English and Irish peasant girls even sold themselves into real voluntary slavery in colonial times, coming to America as quasi criminals or indentured apprentices, to be household servants and work out their freedom, in order to escape the miserable tyranny of the then prevailing domestic industries.

About the middle of the last century steam was harnessed. The spinning jenny was invented—the first blow at *home* industries. Factories for steam machinery were opened, and women and children were drawn from the wretched cottages to tend first the spinning frames, then the looms, and finally the whole array of textile appliances which during the past century have revolutionized production and again emancipated woman. Steam ma-

chinery found her an economic and financial cipher; it has transformed her into an economic and financial power. The invasion of women and children into the lower grades of paid industries has made possible the advance of females into higher pursuits. Untaught manual workers hewed the way for intellectual and professional workers.

I referred a while ago to the new woman's debt to primitive mothers. I would speak now of the new woman's debt to the real working woman; to her who first leaped over the home threshold and broke the fetters of tradition that confined the gentler sex strictly within the domestic sphere; to the first female wage-earners who dared public opinion, suffered odium, and underwent the hardships inevitable to new and untried conditions in order to open up all the noble crafts, trades, and professions on which the girl of to-day enters without strife or penalty. The multitude of pursuits in which the modern Eve may attain higher usefulness and development, the careers that crown her with honor, fame, and fortune, are a heritage to us of the last decade of the nineteenth century from women and girls who toiled in factories in the last decade of the eighteenth century.

These privileges are not of our creation. Let that fact sink deep and make us humble. Enjoying the fruit of economic liberty, we are apt to forget who won it for us. We are even prone to persuade ourselves that *we* won it, prone to magnify and vaunt ourselves, shutting our eyes to the struggles and tasks of hundreds of thousands of ignorant, despised mothers and maids and tiny children whose lives were one long martyrdom in mills and workshops in Great Britain and on the Continent, in order to render gainful pursuits and the control of their own earnings possible for womankind. All the blessings which we accept as a matter of course—the shortened working day, decent sanitary surroundings, frequent payments—are the outcome of a hundred years of toil and stress, of snail-like legislation following on timid protest, of concessions wrung from careless or hostile public sentiment, until, finally, the present factory acts were secured.

Nothing in history is more dramatic than that bitter industrial revolution by which the factory system displaced the domestic industries. Machinery came to stay. It had to be fed, fed actually with human fuel, females and little ones scarcely out of babyhood being set to tend it in buildings hastily constructed, in barns or barracks on village outskirts and in temporary sheds near cities. When in sparsely settled districts there was lack of small hands to run spindle and loom, the dregs of the population were utilized. Women, and children down to four and five years old, were brought in droves from afar, or taken from almshouses or pauper institutions and even from the prisons. These miserable crea-

tures, let in gangs to the manufacturers, were herded like animals in the mills and forges, sleeping under the machines, eating there such poor food as they had to eat. Tasked day and night and often days at a stretch, they were rudely shaken from brief slumber to renew their work, and were goaded to labor by the whip.

Generation after generation of English factory operatives was thus martyred, devitalized, degraded, before reaction of public feeling and tardy legislation gradually combined between 1802 and 1876 to repress these abuses. So, by toiling sixteen and eighteen hours out of the twenty-four, by living in stables, by being beaten and starved under employers drunk with avarice and power, these early mill hands—grandmothers, mothers, maidens, and tiny children—bought with blood and tears the right for woman to compete industrially with man. In this sad, this heroic effort, a million beings were engaged whose lives were needlessly shortened or sacrificed to the dreadful treatment and surroundings they had to endure before the cry of their pain was heeded by the lawmakers, before a century of suffering, demoralization, and oppression forced into existence that great saving and preventive agency, the British Factory Acts.

The crusade for government interference and protection of the wage-earner against insane and inhuman greed—alas! even the greed that makes parents wreck their offspring by early labor—was carried on for seventy-five years by men alone. I am sorry to count no feminine helper among the reformers, to blazon no woman's name alongside Lord Shaftesbury's.

In the United States the first mill employees enjoyed a better fate. Nevertheless, long working hours, the toil of ignorant children, and other abuses of unrestricted industrialism early called for remedy; and since 1840 Massachusetts has led the ever-widening movement for regulating factories and improving the condition of labor.

The American girl who profits by this hard-won emancipation, to whom has fallen the precious heritage of economic independence, who is able to-day to pursue freely and at ease in laboratory, studio, office, and workshop all the skilled trades and professions only because other humbler sisters have trodden a rougher path and cleared the way by manual effort, this "new woman" owes to all female breadwinners commensurate gratitude and many sacred duties.

First, by virtue of ampler leisure, superior education, and social importance, we owe *protection*. Do we give it? No. It is a significant fact that while in England the Factory Acts were secured mainly by men of rank, wealth, and public spirit *for* the laborer, in America such statutes usually originate with and are pushed through by the workers themselves, half educated, un-

aided, handicapped, and sometimes intimidated by unprogressive employers. When measures come before our Legislatures to better the conditions under which females toil in shops and mills, and to raise the age limit after which the child may be condemned to labor, women, with noble exceptions like Mrs. Josephine Shaw Lowell, are conspicuously absent, while even many clergymen enroll themselves on the side of *laissez faire*. True, our sex is conservative, frightened by prophecies of socialist rule, inclined to regard factory legislation as anarchistic instead of remedial and preventive. Another feminine inconsistency is that women busy themselves and beset the Solons about paupers and the degraded, about institutions and charities, though refusing to lift a hand or lend their indorsement to obtain protective legislation for respectable, self-sustaining working women and helpless children, who from dependence for employment on the favor of merchants and manufacturers are unable to speak in their own behalf. Yet these patient wage-earners, if properly safe-guarded from insanitary surroundings, dangerous and poisonous pursuits, long hours, and excessive strain *while at work*, would so seldom be found in hospitals, institutions, poorhouses, and prisons that the occupation of the board of lady managers would be gone.

Throughout the Union child labor is surely diminishing, as a result of growing public disapproval and of factory laws in half the States; but in large cities and in States that have inadequate factory inspection—practically all except Massachusetts—and no age limit for employment, the mill child and the "cash" child alike are victims of the same evils—low vitality, premature breakdown, dense ignorance, transient employment from shop to shop, and unthrifty habits. Some callings are positively fatal to children; other vocations cause them to be stunted, crooked, or atrophied—a race apart, haggard, wizened, old. The ignorance of working children is often appalling. They do not know their age or birthplace, or the name of the country they live in. They can read and write no language. To say that these little toilers are learning trades is the cruelest falsehood. Whether engaged only in what seem easy and harmless pursuits, standing in stores till eleven o'clock at night in holiday season, in a candy factory one week, in a box shop the next; whether trotting after the mule spinners thirty miles a day, or running forty miles a day fetching and carrying for the glass-blowers; whether tending cutting presses that chop off their fingers, or gilding frames whose metal poison paralyzes their hands, or roasting slowly before cracker ovens, the working children under fourteen years old are nearly everywhere the same—dwarfed, physically defective, mentally benighted, demoralized, unstable, migratory. "Little wonder," says Mrs. Stevens, Assistant Factory Inspector of Illinois,

"that each year finds increasing numbers of wage-earners who can do nothing well, who have no manual skill to command living wages, who in the best times are on the verge of starvation, and at every economic upheaval topple into the abyss of pauperism."

Out of 340,000 children of school age in New York city, 50,000 are untaught for want of school room, because of ragged clothes, or unwillingness to learn. Twenty-eight thousand more children of school age are employed in stores and factories.

Who should act for this toiling army of little ones, should guard the human race from degeneration, should demand the enforcement of existing laws and the making of better laws in their behalf, should secure the building of schools, the expenditure of more money for kindergartens and primary and industrial education, unless it be intelligent women?

Our mission it is, too, to bring about better housing of the poor and the artisan, to insist upon their *right* to decent dwellings, fresh air, pure water and plenty of it, clean alleys and courts and some privacy in their homes—conditions without which those engaged in productive industries can with difficulty lead moral and virtuous lives. It is a mistake to suppose that workers and honest poor folk are satisfied with any miserable abode. Many of them are ambitious. They have the home-making instinct and turn their pitifully small resources to admirable account, surrounding themselves with dainty neatness and refinements in spite of wretched quarters and overburdened lives. I know whereof I speak, having studied the tenements of every large city and many manufacturing centers in the United States. Not long ago I spent four months in a house-to-house, room-to-room investigation of parts of the most congested "slum" districts of New York and Philadelphia. I visited 1,400 tenements, 1,600 families, and 7,250 individuals.

The woman with liberal training, a competence, and social power is the natural guardian of the civic rights of her humble and ignorant sisters, whose civic wrongs she must also have imagination enough to discover by putting herself in the needy fellow-creatures' place, bringing to bear upon their problems her own broader insight and nobler vision. To put yourself in another's place signifies to empty yourself of self. Use imagination, project yourself for the time being into the life of another. *Be* a poor man, an ignorant man, with limitations and the scars of suffering and want, narrowed by lack of opportunity, perhaps embittered by hard treatment and ill success. Be all this, however, *plus* yourself, your brain, your vitality, *plus* your enlightened conscience and your big, deep heart. Then indeed we have a man, not a one-sided mortal, rich and learned *but* nothing else,

or poor, ignorant, and callous, *and* nothing else. The student, teacher, scholar, reformer, or philanthropist is only half a man. He knows principles, but not what it means to pinch and starve, to beg for work without finding it, to see his savings dwindle while capital recoups itself. Piece the scholar or reformer and the workingman together, and we get a complete and useful entity, a being capable of attacking the world's woes without aggravating them. Put yourself in the place of those you propose to aid, and then indeed your help becomes not charity, but brotherhood.

To the least observant it is plain that the manual workers who to-day represent those factory operatives that led us to economic freedom are far less skilled in many branches of industry than were their primitive forbears or their ancestors under the domestic system of trades. Steam-power inventions and appliances tend to change the wage-earners who watch them into soulless, almost brainless, machines. Labor is now so specialized that one repeats endlessly the same process—feeding presses, turning cranks, guiding seams. Reason is stultified, sensibility is deadened. All-around perfected craftsmen exist no more. Who conserves the artistic workmanship, the æsthetic and industrial skill of the primitive female? It is not displayed by our proletariat, certainly, as Prof. Mason remarks; for when we take the exquisite sewing of the Eskimo women, done with sinew thread and needle of bone, or the wonderful basketry and pottery of our American Indians, or the feather work of Polynesia, or the loom products of Africa, and compare them with the tasteless, useless decorations and clumsy needlework of the untrained daughters of our laborers and mechanics, the comparison is all in favor of the wives and daughters of the degraded savage. Household knowledge and pursuits are at the lowest ebb among many of our industrial population. The mothers and girls can neither cook nor sew, nor wash and iron, nor care in the simplest way for the body. Ignorance causes the death of infants and the ill health and poverty of adults, whom poor food robs of their only capital, the power to earn.

Not only over the homes of workers, but over the shops, foundries, mills, and factories, the curse of incompetence hangs. Unless the grade of labor improves, the pay of the skilled workman will be still further lowered by unskilled competition. Our wealth, our greatness, depend on the mastery of industrial arts. It helps us little to be the largest coal-consuming and most inventive nation on earth, if the era of machinery is to be also the era of blind force; if behind the machine we have not the trained hand and eye, the taste of the designer, the skill of the architect and wood carver, the science of the shipbuilder—in short, manual

dexterity re-enforced by art. However we pride ourselves on mere material resources, without industrial power and technique the rest of the world will beat us. Japan and China have developed their exquisite textiles, bronzes, and faïence for four thousand years. Russia has greater oil fields than America. If Egypt and India fail to out-acre us in cotton, Africa could be turned into one vast cotton field where the three economic factors—food, shelter, and raiment—would be minimized, since the cultivator would wear no clothes, would sleep under a tree, and, when he wanted food, would climb the tree and get it.

Clearly, too, we shall continue at an ethical as well as a commercial disadvantage unless we replace the handicrafts of the primitive woman and build up the industrial arts—the all-important, ever-dignified and beautiful pursuits of cooking and sewing, cleaning and repairing, needlework, embroidery, carving, coloring, and house decoration. The most unlovely homes in the world are the bare, untidy homes of our working population. The most wasteful housewife on earth is the thriftless American housewife. To reinstate the skilled industries, to weave in beauty with the life of the people, we must carry manual and technical training and applied art to the point of action, as it were, down among the degraded, the belated, the neglected, the submerged. In the "slums," where ignorance revels, crime festers, and decent poverty hides, we should found cooking, sewing, and housekeeping schools, with carpentry centers, wood-carving, brass-hammering, drawing, modeling, and other creative pursuits that will fascinate the roughest street girl and transform the boy "tough" into an eager, industrious artisan. Belgium and France, whose products we in vain try to equal, have planted industrial and domestic science schools in every hamlet, technical schools in all the manufacturing towns, dairy and farm schools in the agricultural districts. The teaching is adapted to local industries; on the coast, to shipbuilding and fisheries; in the quarries, to stone-cutting; around textile mills, to weaving and dyeing; with drawing everywhere. Hence the industrial supremacy of these countries, their excellent food, absence of waste, national thrift, and the love of art that pervades even the humblest classes. To educate by the same methods the children of America, to improve our homes, to bring order, skill, and beauty into the barrenest lives, to carry on the propaganda for universal industrial and art training, is the privilege and duty of the "new woman."

Two words of warning. Even to dabble in handicrafts and æsthetics is a sign of the crude and amateurish but noble upstriving of our times, just as it indicates awakened civic conscience that club women settle in one hour's discussion the most far-reaching municipal problems and the gravest financial issues.

One fault, however, of modern industrialism is that girls rush hastily, blindly, and sometimes unnecessarily into self-supporting pursuits for which they are unfitted, and to the neglect of a legion of home duties. The desire for pin money, for more to spend on dress than clerks or mechanics can afford their daughters, sweeps into the ranks of competition a whole army of frivolous workers too young to understand the responsibility of the industrial career, untrained for it, and determined to end it by marrying the first *bona-fide* suitor. Such young women, half maintained at home, fond of excitement and of the crowd that congregates in shops and factories, thinking chiefly of self, unidentified with the interests of persisting labor, enter the economic market not on a fair business basis, but accepting any pittance that will supply pocket money and gratify their natural and in some respects commendable desire to make a good appearance. Then, having cut down pay below the life line for the self-supporting toiler, these transients join in condemning merchant and manufacturer for offering no more than starvation wages. Better economic conditions for women will not come until they enter the field less hastily and on strictly business terms; until they are trained enough, stable and responsible enough to deserve these ameliorations, and capable of the concerted and unselfish action required to win them.

Again, the true, the ultimate aim of education is not to prepare for mere self-seeking skill and the acquisition of wealth or social pre-eminence, but for life and a choice between difficult distinctions of right and wrong. The highest life consists in constant development of new aptitudes for usefulness and new faculties for enjoyment; and of this intellectual and moral life woman is the creator and the guardian. Its stage, if she be but a mortal, its altar, if she be a divinity, is the home.

The noblest use for the industrial arts and domestic sciences is to raise our daily living to loftier hygienic and ethical standards. Whether or not outside vocations offer for the sex, or a career independent of marriage be chosen, the true apostle of culture and promoter of industrial skill will strive to lift the popular ideas of sanitation, nursing, food preparation, ornament, beauty, education, and physical development. The "new woman" threatens to turn her back on the home which the primitive woman evolved. But, in reality, all paths revert to it, wherever the rationale of progress may lead her—whether to become sociologist, teacher, artist, writer, practical worker, reformer, or even voter. Only in the restful, well-ordered home does "earth reach its earthly best."

THE BANZIRIS OF THE CONGO BASIN.*

By M. F. J. CLOZEL.

THE territory of the Banziris extends along the northern shore of the upper Oubanghi between the rivers Ombela and Kouango, Africa. They have also a few villages on the southern shore that belong to the Congo Free State. The whole number of Banziris on the north shore may be about four thousand; we lack data for estimating the number of those on the south shore. The tribe is not, therefore, numerically very considerable, and their territorial extension is still less than might be supposed from the number of the population. In fact, they occupy only the edges of the shore. Their cultivated lands are of small extent, and the water is their real element. They deserve attention in the first place as navigators—carriers in a part of the river where steamers penetrate only with great difficulty or do not penetrate at all. They have transported one after another the various French expeditions to the country, they help keep up intercourse between the European advanced posts, and they are a chief resource of the commercial houses in the region. When they are not employed by Europeans they carry on commercial ventures on their own account on the upper Oubanghi and its affluents, or, rather, they undertake long fishing trips to secure a provision of smoked fish for their families. The fishery is furthermore an affair of so much importance to them as to determine real migrations. In the dry season, when the low water uncovers the sand bars of the river, three quarters of the population—men, women, and children—abandon their villages on the land and establish themselves in the middle of the river, where they can fish more conveniently. The provisional establishments set up here do not cost the Banziris much time or material. Their round huts are made of mats of plaited straw, held by a few stakes, and covered by a pointed, thatched roof. The houses in the shore villages, a little larger and more solid, are round like the others and indifferently kept. The real dwellings of the Banziris are their pirogues, and these are their refuges when their neighbors of the tribes to the north press down upon them too closely. These pirogues, hollowed from the trunk of a tree, are usually from thirty to

* Much of the information in this paper was obtained through Bonga, a ten-year-old son of chief Bembe, and very intelligent for his age. The father was one of the most influential men of his tribe, and the first who on the embassy of MM. Crampel and Ponet came to them and accepted the French protectorate. Bonga, after two years' residence with the French, learned to speak the language well, and did excellent and conscientious service as an interpreter.

sixty feet long, from two and a half to three feet wide, and fifteen or eighteen inches deep. Their sides, especially on the bottom, are left very thick for protection when they run aground or strike the rocks in passing the rapids. They are full aft and astern. The prow is surmounted by a small oval platform, cut out of the log, and carved more or less elaborately; on the poop is a small round seat, likewise shaped out of the log. The pilot sits here.

A quarter or third of the whole length, in front, is left free. The three or four polers who propel the boat work in this space. They go and come in file, generally with the gymnastic step, striking the platform, already mentioned, with their feet to give them spring. The passengers and baggage are amidships, and a half dozen paddlemen behind, seated on the sides of the boat, assist the polers in hard places. The crews change places every two or three hours. The management of the long and heavy poles, which, in time of high water, have to be from twenty-five to thirty feet long, is much more laborious than that of the short paddles.

There are generally one or two women on board to do the cooking and keep a fire constantly burning on an earthen hearth in the bottom of the boat. An encampment of Banziris offers a picturesque scene, with the pirogues beached on the shore, the crews grouped on the sand, each around their fire, and the long poles stuck in the ground near them, like so many gigantic lances. On the route in fine weather their songs, and the races between landings, with their lusty cries, and all trying to splash the rival boat, make the hours pass pleasantly. Their boisterous gayety is as wholesome and fresh as that of the young demigods of primitive Greece. They have a sculptural beauty, with their well-developed busts and vigorous limbs, the muscles of which have been well brought out by their rude sailor's life; and their nudity, and even the color of their skin—black, with a coppery tinge like bronze—complete the picture. They show their quality in the hard passages, when the pirogues pass the dangerous rapids, when they throw themselves into the whirling waters to hold the boat up or push it on, and they ward it off with their poles from the rocks at the precise moment when it seemed about to break against them. They are wonderful swimmers from infancy. As soon as he is four or five years old the little Banziri is given as his first plaything a pirogue and a paddle suitable to his size, which he sails alone in the creeks around the village. Their features are pleasant and rounded in graceful curves, with not excessively broad faces, full cheeks, round and shortish nose, not flat, the lips not too thick, revealing admirable teeth, and large black eyes, intelligent and merry. They

seem very much like the ideal savages of the philosophers of the eighteenth century. They address strangers as their friends, and wear the amiable and pleasant smiles of children.

They eat dog-meat with great relish, drowning the animal and cooking it without skinning or dressing it. This meat is rigorously forbidden to the women, who have no part in preparing the dish. They believe, or affect to believe, that it would make women sick. So rigorously is the prohibition kept, that the Banziris wash themselves carefully after eating dog before touching a woman, if only with the tips of their fingers. Schweinfurth maintains that dog-eating is an indication of cannibalism, but the Banziris strenuously deny every charge of that kind. Besides the edible dog, their domestic animals are a few goats and hens. But the basis of their food supply is afforded by the fishery. They cultivate the banana and manioc, and, as accessories, tobacco, sesame, a little corn, and millet. This agriculture is carried on in a commercial way by family or village groups.

We could not learn whether the Banziris have any elements of religion. They wear no amulets and have no visible fetiches. We observed only one sign of superstition among them. Before starting a-fishing they planted some twigs in the ground, put in the midst of them a handful of cowries, and sprinkled them with fat. The ceremony was supposed to secure an abundance of fish to the one who performed it, but I never learned to whom the sacrifice was offered. The political organization of the people is not much more developed than their religious faith. He is chief who has the most wives, children, slaves, pirogues, and particularly who has boldness to carry on transactions with the whites in the best interest of the tribe. On the death of the father the eldest son inherits the pirogues; the other goods are divided, while the lands are the collective property of the village or the hamlet.

Men and women go nearly nude. A little breechcloth of native goods, made of the bark of a species of *ficus* described by Schweinfurth, composes all their dress. The men when they go sailing put off even this little bit of clothes, to avoid soiling it. Girls continue totally naked till they are married; three cowries, a few pearls, or a little bell hanging in front of their bodies and held by a belt of pearls or a narrow leather strap, emphasize their nudity. Beads, in necklaces, in armlets, or pins and beads in the hair, form an important element in the toilets of both sexes.

The young women are very charming. Their type is the same as that of the men, but their features are more delicate, with straight nose, small mouth, and slender but not too thin forms. They are sociable with the whites and make themselves innocently agreeable to them as they would to young men of their own tribe, but always with discretion; and they seemed to excel all the other

negroes we met in strict virtue, in behalf of which they appear capable of resisting the strongest temptations.

Marriage is preceded by a long courtship, with gallantry much after the European style, and takes place usually when the young woman is from sixteen to twenty years old. The Banziri who marries a Banziri girl pays her father with a large number of *guindjas*, or the iron picks that are used exclusively for money. A great feast is then given, during which the women dance and the men drink much palm wine. The bride keeps the house for two months without going to the fields or taking part in any of the household work, while the men do the sweeping and till the garden plot. Polygamy is general, but except with rich and influential persons, the Banziris rarely have more than one free wife. The other wives are slaves. The rejoicings and ceremonies observed on the birth of a child are the same, whether it be a boy or a girl. The parents build a little altar of boughs, on which they sacrifice a hen. They then anoint the child's shoulders with the blood of the victim, pronouncing a formula which may be interpreted as a prayer that the child may be preserved from sickness and disaster. Circumcision is not practiced, and the people are disposed to ridicule the men of the surrounding tribes who use this rite.

On the death of a Banziri, all the men of the village attend the funeral banquet, for which many goats are slain, and which lasts two or three days. If the deceased was a chief, all the women shave their heads as a sign of mourning; two slaves are slain and buried with him, and generally also the one of his wives who is judged least deserving. The corpse is interred in a squatting position in a round pit. A blood penalty is exacted for murder. It can be paid in pearls or by the gift of two slaves. If the parties disagree concerning the price of commutation, a sort of vendetta arises between the families. A thief, if a slave, is punished with death; if a freeman, he is sold on the third conviction as a slave.

The arms of the Banziris are hand knives and throwing knives, assegaies, bows and arrows, and oval shields of osier—all similar to the arms of the neighboring tribes from whom they usually come; for the Banziris have but little enterprise in any arts but those which concern their pirogues and fishing tackle, and would rather buy than make.

The articles of trade most in demand and current before everything else are the little white glass beads called *bayaka* on the Congo. Blue and red ones are accepted, but in small quantities. Cowries, which were in great esteem before the Europeans came, have lost most of their value, though they still have a restricted currency. European picture books, copper armlets, knives, and mirrors might do for presents, but would not be regarded as cur-

rency. Cotton goods will pass in small quantities; and firearms and powder are beginning to be in sharp demand.

The headdresses of the Banziris might by themselves form the subject of a whole article. They are built up by women—the mothers, wives, sisters, or friends of the wearer, who weave plaits, tresses, or cords in the hair of the dandies, and adorn them with beads. There is nothing grotesque about the structure; and the model, chosen with the most accurate taste, is always appropriate to the physiognomy of the patient—a word we can well use here, for it takes about eight months to perfect the dressing.

The hair, parted over the back of the head, is brought over to the sides and made up into a number of small tresses which are crimped and rolled into a considerable truncated cone above and a little behind either ear. The top of the section is formed of a larger tress adorned with beads. A series of braids rolled upon one another in the circular contour gives this scaffolding a very curious aspect.

Particular pains is taken with the two bands forming the outline of a shaven triangle over the foreheads which is very common in Banziri toilets. They are formed of natural hair plaited with leaves of herbs. A square of hair and a square of *bayaka* beads, and then lozenges, form a very graceful design. Other headdresses are less complicated, but in all of them beads are associated with hair in a variety of braids; and this accounts for the time it takes the most skillful hairdressers to perfect their masterpieces. If the elaboration of the structure calls for it, hair is borrowed from slaves or from the dead. The false braid is rolled up on top of the head, or falls gracefully from it. Over the forehead is the shaven triangle bordered with bands of hair set with beads. Sometimes cowries are combined with beads; and the details of the contrivances vary infinitely. Men of war usually wear a tuft of cock or parrot feathers in their hair. After the death of a near relative, pearls, cowries, false braids all disappear, and men and women wear as a sign of mourning their hair as Nature gave it to them.

The Banziris differ in language, customs, and physical appearance from all the surrounding tribes, except their eastern neighbors, the Sangos, whom they much resemble. Opinions may vary as to their origin, but the fact about them that makes them an exception among all the non-Mussulman negroes I met from the Loangos of the coast to the Mandijas and Saras of the unexplored regions is that they are pleasant and their women are graceful.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

ENRICO FERRI ON HOMICIDE.

By HELEN ZIMMERN.

FIRST PAPER.

ENRICO FERRI, the pupil and collaborator of Cesare Lombroso in the science of Criminal Anthropology, which the latter may almost be said to have created, has just published a truly monumental work consisting of over seven hundred closely printed pages and an appendix of over three hundred, in which he subjects to a most searching and minute examination the problem of homicide from the point of view of Criminal Anthropology. In it he treats of the murderer by instinct or from madness, reserving for future treatment the cases due to occasion and passion. This huge book is the result of nearly thirteen years' work, during which it has been often interrupted by Ferri's legal and parliamentary labors. These interruptions have not been without their benefit. As a criminal lawyer he had much opportunity of coming in contact with criminals and of studying them closely, and he is convinced that his work has gained rather than lost from the circumstance of its having been so long on the stocks. He has taken as his watchword Michelet's "La science de la justice et la science de la nature sont une. Il faut que la justice devienne une médecine s'éclairant des sciences psychologiques et physiologiques"; and it is on these calm lines that the whole work is penned. The author's purpose, in writing this book, was to demonstrate the methods by which we should endeavor to study the natural genesis of every crime in order to acquire positive and special knowledge of the causes of criminal phenomena, to deduce thence certain indications as to the most efficacious remedies, which should be at the same time the most effective and the most humane, to be applied against these symptoms of social pathology, to bring into relief more especially those data which will explain the genesis of murder, serve to delineate its psychological diagnosis as it affects each individual who commits it, and hence give the degree in which he is to be feared, according to the anthropological category to which he belongs. Starting from the axiom that the elementary notion of homicide as a criminal fact—that is to say, that the murder of one man by another is totally inadequate to satisfy the demands of contemporary penal science, which has been fundamentally reconstituted by the new methods of positive research—he deems that he must conduct his study to the true origin of these phenomena. Hence the necessity of a twofold inquiry: first, that bearing on the natural evolution of homicide, which includes in its vast domain the

historical evolution that forms the theme of the last chapter, and consequently those which bear on the natural causes of homicide. It is necessary, therefore, to commence with animals and end with man, who is but the last link in the same chain.

Simplifying and generalizing the elementary notions that prevail on the matter of homicide, it may be said that it is the destruction of one animal by another of the same species. Homicide as a criminal fact does not consist in the act of taking life—since killing in order to live is a natural law, and hence is moral—but in killing a being of the same species. All beings of a superior species kill those of an inferior one in order to nourish themselves. The deed becomes criminal only when it is unnatural. This fact of unnaturalness defines it as a crime.

Sociology of late has planted its pioneers in the ranks of zoölogy. This was done by Lombroso in his Criminal Anthropology, and on these lines all scientists work nowadays. These scientific conclusions, which affirm the strict relationship, psychological as well as physical, existing between man and the other animals, every day demonstrates as more true. Hence the embryology of murder must be sought in the obscure depths of zoö-psychology, for it is now certain that the criminal activity of man is only the reproduction of animal criminality, developed and modified by means of intelligence. Homicide is a primitive crime like theft, and can be found in nearly all its forms and variety of motives in the animal world. As in man so in beasts there are races more prone than others to the taking of life, beings who transmit the murderous instinct. The classification of animal criminology made by Ferri can therefore be extended to man. Utilizing the studies and researches in animal psychology made up to the present, the author classifies in convenient grades a goodly number of the most accredited facts, demonstrating how homicide manifests itself in the animal kingdom. These facts are more numerous than would be generally imagined, and well adapted for precise classification. The first group, which relates to the different aspects of the struggle for life, nutrition, social supremacy, and sexual reproduction, deals with the crimes due to the natural laws of existence. The general character of this group presents a minor degree of perversion than those of premeditated ones of the second group, which includes murder determined by an instinct in the species. Animals destroy each other from sexual instinct, for love, maternal affection, for defense, for the common weal, for punishment. With respect to this last motive—punishment—among animals, which some deny, considering it a mere question of vendetta, Ferri maintains that among animals, besides this motive, there exists a more or less exact notion of chastisement. Our author admits that it is difficult to distinguish the sentiment

of responsibility from the fear of punishment, but still he holds that animals have a rudimentary sentiment of responsibility. In dogs this sentiment is far from rudimentary. The theme, however, deserves a more extended study, which in this place would have led Ferri too far afield. In any case, as he points out, punishment is not merely a means adopted by man toward man and animals, but is not unknown among the latter themselves. It is above all among animals that punishments are efficacious as deterrents from crime. If monkeys are so thievish in India it is because they are not punished, being held sacred. On the other hand, no punishment can have any effect on certain perverse instincts which have become organic from long heredity. Therefore, where crime is an inborn organic tendency, the need of substituting segregation for the usual punitive methods is evident, in accordance with the conclusions of science which have confirmed the efficacy of penal substitutes for punishment even in the animal world.

That crime is a natural phenomenon can be still better seen when studying the group determined by an antisocial instinct. Ferri asserts that for man as well as for animals every action is determined by a movement of passion, which will be stronger in proportion to the gravity and importance of the act effected, but it always exists, however imperceptible, whatever be the action, and therefore, in studying criminal activity, the principle now dominant in schools and jurisprudence is erroneous, by which passions in their relation to responsibility are distinguished by the degree of their violence—for example, that an overmastering passion can cancel or diminish the responsibility of the individual. This is an empirical criterion, which in studying criminology in man as well as in animals it is needful to substitute by the more scientific distinction of passions which are useful and passions which are harmful to the species, motives which are social and motives which are antisocial. For crimes provoked by social motives have a natural and juridic character of their own and must be judged apart.

In this group of murders of an antisocial character are included those determined by covetousness, ingratitude, war, personal vendetta, antipathies, anger, and the like, which, whether as isolated motives or as concomitants of crime, bear the stamp of individual perversity. The motor impulse must not be confounded with that thus designated by the classical school of criminalists who, when they do not find the cause proportionate to the crime, invent the stock phrase of bloodthirstiness. Thus homicides induced by vendetta, by covetousness, etc., are, according to them, acts of bloodthirstiness. On the contrary, the experimental study of delinquency reveals that homicide without apparent or

proportionate motives is nothing else but the result of abnormal or diseased organisms. However, this factor of bloodthirstiness might better be classified by itself. Perhaps (among the animals who are criminals born), although it has a no less legitimate place among those crimes induced by antisocial instincts where Ferri has placed it, it has also no connection with madness. The classical divorce of crimes from insanity, rejected by positive science, finds also here in the study of innate or acquired bloodthirstiness a heavy defeat. Just as there are good and domesticable animals, so there are perverse ones even among the domesticated, absolutely comparable to the criminal born, as Lombroso and others have contended.

This group of facts brings still more into relief the fundamental analogy between the criminal activity of animals and of men. A yet more eloquent proof is found by studying the group of murders induced by mental alienation and by cannibalism. From *l'homme machine* of Descartes we have come to insanity among animals, concerning which there is no manner of doubt, seeing the result of recent studies, and this means that brutes have in common with man various mental maladies, differing only in degree.

Ferri divides into five categories the cases of murder among animals determined by madness, no matter whether transitory or permanent, innate or acquired: murder by hereditary tendencies, by mania, by impulse of fear, by senility, by alcoholism (for the effects of alcohol in all its divers forms on animals are well known), and subjects them to a brief but deeply interesting examination. All the murders enumerated have their scope and limit in the murder of their fellows. In animals, as we also see among savages and even among civilized peoples, crime is continued with outrages on the corpse and with cannibalism. The origin of this unnatural mode of alimentation must certainly be sought in the need induced by hunger. It is only after that that cannibalism becomes an organic tendency in animals and man. However, man has motives for anthropophagy different from those of animals. Ferri classifies cannibalism among animals in two categories, simple cannibalism (wolves, rats, etc.; Lombroso also cites the case of a dog), and cannibalism among relations—that is to say, infanticide and parricide (crocodile, fox, etc.). To render this exposition of crime in animals yet more complete, the author hints at another possible class, suicide, which is certainly not unknown among animals.

Having thus passed in review all the categories of crime in animals, Ferri devotes a chapter to drawing from the facts he has accumulated their obvious and special conclusions, pointing out the striking psychic analogy of motive and of execution existing

between the human and the animal world, once more insisting on the undoubtedly natural character of the crime. He then passes on to examine homicide in primitive savage humanity, which is an intermediate form of homicidal evolution between the animal and civilized society. Concerning the importance of these studies of savage peoples, as well as concerning the modern reconsideration of the conditions of primitive humanity deduced from the study of contemporary savages, doubts have been uttered and objections raised even in the ranks of evolutionists. Ferri, however, who is convinced that the paleontological data can, for lack of other evidence, be elicited from these analogies with contemporary savage life, accepts the evolution hypothesis that in contemporary savages is seen reflected a large portion of the primitive conditions of humanity.

The purely descriptive style adopted by Ferri in his study of animals in the second chapter of his book is interspersed with psychological reflections, for though at the outset his purpose was to prove the existence of criminal murder among animals, he had also to study not only the manifest existence of this murder, but to show that such acts have their moral as well as their juridic side. To do this he examines and classifies divers forms of homicide in primitive humanity, beginning with the least fierce and ending with the most repulsive, while leaving aside those common also to civilized man. Here we find new criminal aspects: for example, abortion; infanticide, elevated to a custom and a method in Malthusianism; the killing of the old, of women, of the sick, of those unable to work, of useless mouths (practiced also in historical primitive times), homicide for superstition, race hatred, vanity, homicide without apparent purpose, for bloodthirstiness, frequent in savages by reason of the very brutality of their nature and the small account in which they hold their lives; finally, cannibalism, the most repugnant and ferocious form of homicide, common to all the peoples of antiquity according to Vogt; born of hunger, of warlike fury, of need, and transmitted by heredity, by religious tradition, and lastly, the ultimate grade of human ferocity, by gluttony. We see this crime reappear in part and without the stimulus of hunger, for vendetta and simple anger.

This classification of the various forms of homicide presented by Ferri in a growing scale of ferocity, in order to give contrast to the two extremes of primitive and civilized man, does not tally, as he himself points out, with the duplex process of natural evolution which can be studied in primitive man. In fact, here we have on one side a continual diminution and disappearance of the most repulsive forms of crime, and on the other side the ever-increasing development of moral sentiments and of the juridic instincts, such as we find afterward in history. Some forms of

homicide, such as cannibalism, blood revenges, etc., where they do not entirely disappear, become less frequent, are less tolerated, and assume more moral and juridic aspects (juridic homicide and cannibalism as a punishment for evil-doers), and this new aspect constitutes the embryo of the succeeding social right of repression.

After this extensive analysis Ferri thinks he is justified in asserting that savages do not entirely ignore any notion of crimes and of punishment, and if some peoples lack the sense of crime, the majority consider as punishable a certain number of criminal actions, although no doubt these are few as compared with the number existing in our actual codexes. After this review of primitive homicide, although the ethnographical study of criminality and legislation is still incomplete, Ferri believes he may draw various conclusions, of which the most important are: "As among animals, so among savages, these more or less atrocious facts are not alone the effects of specific race tendencies, but also occur among gentle peoples and those relatively less savage. The moral and juridic evolutions against homicide exist hardly even in embryo among the most savage tribes, any more than among animals, and follow, like any other psychological manifestation, the slow evolution of human society. . . . Justice in the moral and juridic sense is essentially relative and variable." As a general and definite conclusion of these preliminary examinations of savage humanity and animals in the order of their criminal activity, it follows, contrary to the affirmation of the schools, that neither punishment nor social innovations will ever succeed in extirpating homicide. But this ideal may be reached rather by the slow labor of progressive evolution.

This interesting examination of the natural evolution of homicide is followed by an inquiry into its natural causes. This second scientific examination needed to be subdivided on the basis of the classification generally adopted by the others (anthropological, physical, and social factors) into three special studies. The combination of the factors among themselves, and the respective prevalence of one of these, determined a special category of crime. Thus the prevalence of the anthropological factor gives us the figure of the murderer born and the murderer by insanity, the main subject of this large work; the prevalence of physical and social factors furnishes us with the figure of the murderer by occasion and by passion, which is to form the theme of the second volume. The anthropological factor in the criminal divides itself yet again into its constituent elements of organic and psychic.

Ferri begins with the examination of the organic constitution of homicide, objecting with great force to the criticisms and methods of the modern school of anthropology and exposing the criterions by which he himself has been guided. It is not easy or

possible, however, to deduce even from these precise criterions anything but an approximate conclusion. Ferri points out frankly, in the brilliant treatise that precedes his study of comparative anthropometry, the difficulties of such classification. He insists, for example, that, besides craniological characteristics and the qualities inherent in the individual and the race, due regard must be had to psychological conditions.

DOGBANE AND MILKWEED.

By MAUD GOING (E. M. HARDINGE).

THE story of the trap-setting and insect-eating plants is a more than twice-told tale. The pitcher-plant, which beguiles the hapless fly to his drowning in its vase-shaped leaves, baited on the outside with nectar-bearing glands, and filled with water; the Venus's flytrap, which shuts up on him and crushes him; the sundew (*Drosera*), which chokes him in a sticky secretion, are all known, at least by pictures and descriptions, to the tyro in botanic study. And we have learned that they all have good and sufficient reasons for thus dealing with the hapless flies. For "the plants grow," says Grant Allen, "in places where the marshy and water-logged soil is markedly wanting in nitrogen compounds. Insect-eating leaves are thus a device to supply the plant with nitrogen by means of the foliage, in circumstances where the roots prove powerless for the purpose."

The insect slaughter which they carry on has the same excuse as the animal slaughter of the abattoir. It is killing for food, and the insects which these plants catch are honestly eaten and digested. But in the infinite analogy of the vegetable world we find a curious parallel to killing for sport. There are a few native flowers which entrap insects simply and solely, it appears, for the deed's own sake. The prisoners serve no apparent use in the plant's economy, nor do their poor little corpses nourish the plant's life. A botanist who let his imagination run away with him might accuse the guileless-looking flowers of that savage joy in another creature's pain which drew our forefathers in crowds to the badger-drawings and bear-baitings of bygone times.

One of these flower tormentors is the spreading dogbane (*Apocynum androsæmifolium*), which is common all summer, along shady roadsides and around the borders of thickets, in the Northern and Eastern States. The plant is about three feet high, erect and branching. The flowers are nearly as large as single blossoms of the lily of the valley, "and are very beautiful," says Mrs. Dana, "if closely examined. The corolla is bell-shaped and cleft, at the

edge, into five slender points. Its deep pink veining suggests nectar," and the insect visitor is not disappointed, for at its base are five nectar-bearing glands. These stand in a ring around the pistil, and in a larger circle, outside the ring of honey glands, are the five stamens. The anthers stand erect, and in shape are like arrow or spear heads. Corresponding to the two points at the base of a spear head, there are, at the base of each anther, two little hard horns, and the stamens ring so closely about the pistil that horn is pressed against horn all around the circle.

On the inside of the corolla, near its base, are five triangular callosities, with their points up. These are placed in such a way as to alternate with the stamens, and stand a little below them, so that the two hard points at the bases of two neighboring anthers, and the hard tip of the callosity—three little horns—come together like the teeth of a trap. There are no fewer than five places inside the flower's cup where these traps are set, and inside the circle of traps are the glands which contain nectar. The flower is visited by bees and flies.

The insect caller must run his proboscis in between the long anthers, and just above the horny excrescences on the corolla. When he attempts to withdraw, after drinking his fill, the three points lock together, like the jaws of a trap, holding the tip of his proboscis in durance vile. If the winged captive is big and strong, he gets free, with a long and a vigorous pull. But small flies are often held prisoners till they die, probably from starvation. Sometimes one may see three or four of these hapless victims on one full-blooming plant of spreading dogbane.

Among the prisoners one may often see a little summer fly of dudish aspect, with body ringed with alternate bands of bronze and gold, and wings of gauze shot with opaline colors. To what end is this bright little fellow sacrificed? Held as he is by the tip of his proboscis, his body does not come in contact with the plant, and hence it can not be digested by the vegetable juices, as are the corpses of the sundew's victims. The dogbane is apparently unable to furnish any adequate justification for his taking off.

There is another variety of dogbane, the Indian hemp, or *Apocynum cannabinum*, which bears smaller blossoms than the *androsæmifolium*, blooms somewhat later, and is more widely distributed over the country. This flower has no callosities in its corolla, sets no snares for insect victims, and is apparently quite innocent of the crimes which one is inclined to lay to the charge of its first cousin.

The common milkweed (*Asclepias cornuti*) also imprisons insects, which sometimes die in captivity, and do no apparent good to the plant by their deaths. They have, however, invited misfortune, for though the milkweed is rich in honey, and is visited

by a large and miscellaneous company, it can be fertilized apparently only by bees and perhaps by a few large flies.

The milkweed is a peculiarly constructed and very highly organized flower. The petals, five in number, fold back as soon as the blossom opens and press their backs against the flower stalk. Inside them, standing upright in a ring, are five honey jars, or nectaries, of peculiar form. Each nectary is hooded, and inside each is an incurved horn. Within the circle of honey jars are the five stamens, which are fixed to the base of the corolla, and stand in contact with each other, surrounding and inclosing the pistil. On top of the ring of stamens is a large five-sided disk, which keeps the pollen from being blown away, or wet with rain or dew. The whole stamen system is like a little tub or firkin, standing in the midst of the flower, upside down. Inside this firkin are two green pistils, which will be two green pods. The pollen of each anther is collected into an Indian-club-shaped mass, which is fastened to a similar mass formed by the pollen of the next anther. Thus the two connected pollen masses belong to two separate stamens. They are united by a tiny black disk. This disk is set just above an opening between the stamens which runs "clear through" to the pistil inside the firkin. The fly or bee stands on the outside of the firkin, and, tramping about there, gets her foot caught on the black disk—which is glutinous—and pulls out (if she is strong enough) the whole affair, disk and attached pollen masses. A bee will gather three or four of these at once, and I have seen one buzzing away from a head of milkweed loaded with no fewer than nine. Thus encumbered, she was for a moment held prisoner by the flower, unable to pull herself and her burden loose. Following the custom of bees, she carried the pollen masses at once to another milkweed plant, and perched upon one of its flowers in exactly the position in which she had stood when visiting the first. This brought the pollen masses on her feet exactly into the slits running through the stamen ring to the pistil.

The bee seems the favorite guest of the milkweed. The pollen masses come out at once at her tread, and are carried directly to the pistil of another flower.

Wasps visit the milkweed for its honey, but I have never seen them withdraw the pollen masses. Flies seldom do, though the flower is visited by flies of many species. Indeed, it is a general favorite, standing in the midst of a winged throng till dark, for twilight brings to it a number of small, dark-colored moths with very long proboscides.

But not all these visitors are permitted to go in peace. A small fly with his legs stuck to the black disks is frequently unable to pull himself loose after he has drunk his fill. On a bunch of

twenty-five blossoms I have counted five flies thus held in captivity — three dead and two dying — and the same bunch had captured a long-legged, lace-winged caperer, whose struggles to free himself were as desperate as futile. On any large bunch of these flowers one can see mementoes of past tribulations. Here and there a blossom still holds a little black leg, the price of the liberty of some insect who has gone off free, but a cripple.

A flower so highly organized as the milkweed seldom receives and nourishes all comers. In one peculiarity of structure the milkweeds are like the orchids, that royal family of plants, for the orchids also send their pollen abroad massed into two clusters, which are united by a disk. But each orchid has its own very select and small circle of guests, and some among them endeavor to please one butterfly or moth friend, him and him alone. They are, in evolutionary language, "highly specialized."

On the other hand, a flower which keeps open house to all comers is generally primitive in color and structure. Such blossoms are apt to be yellow or white, with flat, open corollas, and without spurs, honey jars, or covering to protect the pollen. So the milkweed is something of a problem to the evolutionary botanist. Can he, for example, explain the fate of those hapless flies which, like Haman of old, come to a feast, but get only imprisonment and death? These unfortunates are but a small proportion of the milkweed's fly visitors. The great majority make off, after taking their fill of nectar, without carrying off any portion of the pollen which the flower is endeavoring to send to its neighbors. This waste of nectar is bad for the milkweed, which would be better off with fewer fly visitors. So the flower would profit by any device which would discourage these many flies, without deterring those useful and desired visitors, the bees. Will flies learn after a while to shun the milkweed's dangerous sweets, so that they may all be left for worthier and more welcome guests? And how many generations will it take this proverbially foolish insect to lay the lesson to heart?

A SUBSIDY of one hundred thousand francs has been voted by the Belgian Chambers for the expedition to be led by M. Lieutenant de Gerlache, co-operating with the Belgian Geographical Society, into the antarctic regions. Two seasons are to be spent in the expedition. In the first season, M. de Gerlache will attempt the exploration of the regions around Graham's Land. Then, after wintering in an Australian port, the Belgica, as the vessel is to be named, will sail for Victoria Land, and an effort will be made to determine the southern magnetic pole. While he will reach as high a latitude as he can, M. de Gerlache's chief aim will be to collect data relative to meteorology, terrestrial physics, oceanography, and the fauna and flora of the regions explored.

A CAMBODIAN PRIMARY SCHOOL.

By M. ADHÊMARD LECLÈRE.

THE Véat, or Buddhist monastery, is in Cambodia very much what the Christian monastery was in Europe in the middle ages—a community of persons devoted to religion, having a chapel, a place of entertainment for strangers, and a school for boys. The schools directed by the mendicants are most generally primary schools, where are taught gratuitously and in a spirit of charity to voluntary pupils reading and writing in the Cambodian language and characters; prayer in the dead language of Maghada (or Pâli), which has become the sacred language of the Buddhists of the Southern Church; reading of the *Balery Mokoth*, or Maghada texts, which are written in Cambodian characters on palm leaves; arithmetic; and a little religious morals on "earth to earth."

The superior of the monastery is the chief professor and exercises a general direction over the other professors and the pupils, without personally giving much attention to the instruction. Under him is a monk known as the reading professor, who reads on festival days, in the temple or in the hall of the monastery, from the sacred book, the life of Buddha and a few fragments of his teaching, and in the absence of the superior supervises the observance of religious discipline. The other monks, generally spoken of as gentlemen of the clergy, or of the assembly, or of the church, are addressed by the pupils as the professor or my professor.

All the bonzes can read and teach reading, but there are many who hardly know how to write and are absolutely incapable of reading aloud in the assembly of the faithful. Only a few of them are so advanced as to comprehend what they read without pronouncing the words. In short, although the instruction given in these institutions is very elementary, and there is absolutely no discipline, the Buddhist monks are nevertheless the veritable and only teachers of children, their beloved and respected schoolmasters, and their spiritual fathers, to whom it is "good form" to be submissive, the respected educators of the people.

The pupils are of two kinds—those who are dressed like the laity and those who are dressed like the bonzes. The former are designated by terms meaning children who study, who learn, or pupils; the others are novices. But those of both classes who are of the same age pursue the same courses. Those of the second class, the novices, are incipient bonzes. They accompany the monks who go out in the morning to beg, and, like them, hold out the wooden contribution boxes for the alms of boiled rice. Fur-

thermore, having been consecrated with a little ceremony which does not always take place in the temple, they are obliged to have their heads shaved like the bonzes and to recite with them certain prayers which they have consequently to learn, and they live in the monastery. While the ordinary pupils may sometimes reside in the monastery under special conditions or for special purposes, they usually live with their parents, and resort every morning to the Véat to take their lesson, go home to breakfast, then return to study and perform a few household duties and play with their comrades for a large part of the day under the eye of their kindly and somewhat too careless professors.

All children who present themselves at the Véat for study are received. It is not even required that their parents bring them or visit them. The newcomer chooses his professor, and, if accepted, begins at once to study under his direction, installs himself in his cell or in the school hall, and becomes his servant. If the professor has already too many pupils, he refuses the new pupil and advises him to choose another teacher; sometimes he guides his choice, directing him to a master who has few or no pupils, or takes him to the superior, who will select a teacher for him. The choice of a professor is always a grave affair, because it is held in Cambodia, as in all Buddhist and Brahmanic countries, that professor and pupil are bound by strong ties of spiritual affinity, and that the pupil ought to respect his master as he does his father and mother. The law inflicts the same penalty upon an offense of the pupil against his master and an offense by a son against his father and mother, and it prescribes that in certain cases the pupil may be the heir of his professor when he has cared for him or supported him or served him when studying under his direction; not only a family bond, but a religious bond, too, is established between them, for the professor makes it his business to teach his pupil the course by which he may earn a more advantageous reincarnation and reach the Nirvana, and becomes his spiritual guide.

Four implements are used in studying: a tablet about two feet by one, blackened with black lacquer; a crayon stick; a bamboo ruler as long as the board, with which to draw the lines at which the tops of the characters must stop; and a cloth for wiping the board when it is full. The pupil generally uses the corner of his scarf or girdle for the last purpose.

The teacher writes on the tablet the characters the pupil is to learn, and names them to him; the pupil learns to write and name them all at the same time. His professor is near him, answers him, draws his attention to the often inconspicuous details that differentiate the characters, and to the accents and

marks that modify their value, and shows him, writing on the tablet, how to draw them.

I have often witnessed these lessons, and have much admired both the calm patience of the master and the readiness with which the little Cambodians learn. Their memory is extraordinary, and they keep what they have learned much better than our children do. I do not mean that they know better what they know, and that they can draw on a larger part of their knowledge than our children. No, the little that they acquire thus so rapidly continues with them nearly always as unemployed means, as material not put to use, as unproductive elements of knowledge. Their intellectual development in other respects stops early, between sixteen and eighteen years, but their memory still remains surprising. By memory I mean the recollection of sounds, of the eyes, of figures, of words, and of facts. But they do not know, or only know imperfectly, and hardly learn after eighteen years, how to use what they know, to co-ordinate it, to deduce, to draw logical consequences, to generalize; to give their whole mind to a thing. But good sense, delicate discrimination, mingled with some degree of critical judgment regarding all the affairs of current life, are not wanting in them, even in early childhood.

The first series of characters traced by the teacher includes twenty-four vowels, consonants, and diphthongs, and is called the *nomo*, from the two characters, *no* and *mo*, with which it begins, and which together form a Pâli word. These two characters are followed by four others, *pont, théa, sét*, and *them*, which with the first two form the phrase *Nomo Buddhaya siddhan!* or, "Glory be given to Buddha!"—a salutation which resembles that of the *Croix de Dieu*, or "Cross of God," with which French pupils in the *a b c*'s were formerly accustomed to begin their lessons. The pupil, having learned to read and trace the twenty-four characters of this series, is given the thirty-five characters of the second series, which include various consonants and semi-vowels; then the vowels are given—eighteen hard and eighteen mollified, although the difference is very slight.

These lessons thoroughly learned, the pupil passes to the six hundred and fifty combinations of consonants and vowels, which are very rapidly learned, for the same rule prevails with the combinations of each and all the consonants; so that, when one series is learned, the rest are like it.

When the pupil, after two or three months at the most, has learned all the characters and their combinations, a little *sutra*, or manual, or treatise on correct morals is put into his hands, which he reads in the presence of the professor or one of the better learned pupils, who corrects him and drills him in the good reading of the work, explaining the meaning if he does not under-

stand it. The first *sutra* is the "Custom of Youth," and is repeated every day till it is read without hesitation and without mistakes, and till the pupil knows it by heart and can recite it from memory. Then a second *sutra* is given him—the advice of a grandfather to his grandson, or the "Groups of Customs"—counsels to be followed every day; or the "Customs of Women"—and this book is read till it is as thoroughly learned as the other.

Nothing can be more curious than to attend one of these readings. The pupils are all seated on mats near the door or the windows, each with a different *sutra* in his hand. They read all at once, as loudly as they can, so that they can hear themselves better, without any concern for their neighbors, and without stopping to breathe. It is deafening, and we can hardly understand how the poor little fellows manage to isolate themselves from the uproar of noisy readers that can be heard a thousand feet from the monastery.

Between times the pupil copies extracts from the things he reads; practices in writing a letter, or drawing up a brief, or in setting forth some claim in a good, clear style. When so far advanced that he can give up his wooden slate and the tracing of large characters, he is given some folding books. He polishes the pages of pasteboard or felt with sand; then holding an iron-pointed stylus, with his hand resting on a cushion, steadying the stylus with the thumb of his left hand, he draws it carefully over the page, so as to cut the fiber without tearing it. When he has written on both sides of his long sheet—eight or ten perpendicular lines—in this manner, he takes some ink made of soot scraped from the bottom of the pot and moistened, rubs it with a cloth across the leaf, and then wipes it with a clean dry cloth. The ink remains in the hollows, and the characters come plainly out, as black as our printed characters. The number of those, however, who succeed in learning the more delicate art of writing on palm leaves is comparatively small. After the pupil has learned to write, he is taught such arithmetic as he is supposed to need, including the multiplication table and the four rules.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

MR. WALTER B. HARRIS, in his travels in the region of the Atlas Mountains, observed a peculiar native taste or talent for sculpture among the Berbers. "At Dads," he says, "I saw children modeling in clay little figures of men on horseback, . . . which no Arab or Moor either could or would do. Excellently modeled they were too. I asked a native, and he laughingly replied, 'We all did that when we were small.'"

SKETCH OF SAMUEL LUTHER DANA.

SAMUEL LUTHER DANA, the second son of Lucy (Giddings) and Captain Luther Dana, was born July 11, 1795, in the town of Amherst, not far from Nashua, N. H. He was descended from Richard Dana, who came to this country and settled in Cambridge about 1640. His father was a native of Groton, Mass., and in the latter part of the Revolutionary War entered the navy of the United States as a midshipman, he being then seventeen years of age. Soon after his marriage in 1788 he took up his residence at Amherst and engaged in mercantile business. This not proving successful, he took to the sea again, becoming a shipmaster in the merchant service. He followed the sea until a few years before his death, in 1832, and made about seventy voyages to ports in Europe, Asia, and America. Captain Dana was fond of knowledge, and took pleasure in collecting objects of natural history, many valuable specimens being given by him to the Marine Museum at Salem, Mass. He had no faith in the superstitions with which seafaring men are haunted, and rather preferred to go out of port on Friday. On one of his most successful voyages he left Salem on a Friday, called at two European ports, reaching and leaving both on Fridays, and it was on a Friday that he finally reached home. His daughter-in-law, Mrs. James Freeman Dana, has described him as "tall and well formed, with a sensible, frank, cheerful countenance. He had clear blue eyes, dark-brown hair, which became silvery white at an early period of life, and a fair complexion, somewhat embrowned by exposure." She also speaks of him as ever ready to assist any who might require aid—one whom the weakest or lowliest might appeal to with the certainty of receiving a kind response. Lucy Giddings was married to him when she was sixteen years of age. She was very handsome and vivacious, and managed the affairs of her home and family during her husband's long absences at sea with rare judgment and tact.

As Captain Dana's residence was not confined by his calling to any particular place, he changed it twice for the benefit of his boys. In 1804 he removed to Exeter, N. H., in order to give them the educational advantages of Phillips Academy, and five years later, when the two oldest had been prepared to enter Harvard College, the family removed to Cambridge. Samuel passed through college in the same class with his older brother, graduating in 1813. From a pamphlet privately printed, containing memoirs of several members of the Dana family, it is learned that the two brothers were endowed with the same love for natural science, and entered upon the study of certain branches of it with great

enthusiasm. They often made excursions together on foot through the country lying within thirty miles around Boston for the purpose of examining its geological structure and collecting mineralogical specimens. The result of these researches was a volume on the Mineralogy and Geology of Boston and its Vicinity, published by the brothers about the time they completed their medical studies.

The younger brother also employed himself upon these excursions in searching for entomological specimens, and formed quite a large collection of beautifully prepared insects. This was afterward given to the Linnæan Society of New England, of which the brothers, if not the founders, were among the earliest members. Another taste which formed a strong bond of union between them was their love of music. In college they belonged to the same musical societies.

On graduating from college Samuel began reading law with his uncle, Judge Samuel Dana, then residing in Charlestown, Mass. The War of 1812 was in progress, and young Dana caught the prevailing military spirit. He applied for a cadetship at West Point, but received instead a commission as first lieutenant in the First United States Artillery, with which corps he served in New York and Virginia until the close of the war. In June, 1815, the army was disbanded and Dana resigned his commission.

A younger brother, Nathaniel G. Dana, was a cadet at West Point during the War of 1812, graduating in 1814. He remained in military life until his death in 1833.

Samuel did not return to the law, but took up the study of medicine under Dr. Bancroft, of Groton. Receiving his medical degree in 1818, he began the practice of his profession in Gloucester, Mass. The next year he married Ann Theodora, daughter of Rev. Joseph Willard, D. D., who had been President of Harvard College from 1781 till his death in 1804.

Dr. Dana now took up his abode in Waltham, Mass., where he practiced medicine until 1826. Toward the close of this period he established a laboratory for the production of sulphuric acid and bleaching salts. This enterprise soon developed into the Newton Chemical Company, of which he was chemist till 1834. His friend Dr. A. A. Hayes, in the memorial pamphlet of the Dana family, has testified to his wide knowledge of the properties of substances and his great fertility in original devices for general and technological work. In his manufacture of acids and other chemicals improved plans and processes were early employed, and Dr. Hayes mentions especially Dana's device for deoxidizing manganic oxide by heating it with sulphur in order to form from it (with pyroligneous acid) a crude manganous acetate, then largely used in dyeing a fast brown.

The second of Dr. Dana's published writings was issued in 1833, while he was on a visit to England. It was a clear exposition of the chemical changes occurring in the manufacture of sulphuric acid.

In the following year Dr. Dana became resident and consulting chemist to the Merrimac Manufacturing Company at Lowell, Mass., in which position he remained for the rest of his life—a period of thirty-four years. The improvements which he introduced into the processes carried on in the mills of this company were many and important. Dr. Hayes gives an outline of these. He undertook systematic researches on the action of the dung of beeves—then used for removing the excess of mordant in printing calicoes with madder—which resulted in the discovery that crude phosphates in a bath with bran are a complete substitute for the expensive and disgusting material before deemed indispensable. Arseniates, which are cheaper than phosphates, were afterward substituted for them on the suggestion of Mercer, and are the world-wide reliance of print manufacturers at the present day.

Of the same systematic character was his study of the chemical changes involved in the process of bleaching cotton fabrics preparatory to printing them. This inquiry resulted in his inventing a method which not only received high commendation as scientific work but was universally adopted in practice. As most of Dr. Dana's researches were made for the exclusive benefit of the company with which he was connected, their results were not always published promptly, and hence the abilities that might have won a high meed of fame remained known to only a small circle. His discoveries with respect to bleaching cotton, however, were published in the *Bulletin de la Société Industrielle de Mulhouse* in 1838. The principles therein established have led to the American method of bleaching, of which Persez, in his *Traité de l'Impression des Tissus*, says that "it realizes the perfection of chemical operations."

The Merrimac Mills were at first run by water power alone, but when the works were extended this was supplemented by the use of steam. Dr. Dana was now called to the new field of engineering, in addition to his other duties. His development of the whole subject of the evaporative power of coal and the economical disposition of the heat in steam and in water of condensation is a masterly effort, embracing every detail, and was in advance of any published results of the time.

For several years before he became a resident of Lowell, Dr. Dana was frequently called to that city as a consulting chemist. He was also one of the chemists consulted by the water commissioners of both Boston and New York prior to the introduction of the Cochituate and Croton water respectively.

"While these varied applications of science to most useful purposes were daily occupations," says Dr. Hayes, "he was pursuing in his laboratory the great study of his life—madder, its products and its application to dyeing—year after year. He deemed the subject exhaustless, and while following the published results of other laborers in the same field as test trials, I happen to know that the most important discoveries, from time to time, were made by him, and often applied, before their publication by others.

"The laboratory, in most busy moments, was exceptionally neat; the deft handling of the apparatus and order of experiments expressed the system of thought."

Soon after removing to Lowell, Dr. Dana became interested in the action of lead upon water, and made a report to the City Council of that city on the danger arising from the use of lead water pipes. His translation and systematic arrangement of the treatise of Tanquerel on Lead Diseases was considered an important contribution to medical knowledge. The discussion of the lead-pipe question gave rise to several pamphlets from Dr. Dana's pen.

Another division of chemistry in which Dr. Dana did valuable work was its application to agriculture. As the outcome of a comprehensive series of experiments and observations, he published, in 1842, The Farmer's Muck Manual of Manures, which was the sheet anchor of libraries in the rural districts of New England for many years. The next year an Essay on Manures submitted by him won the prize offered by the Massachusetts Agricultural Society. He carried into his agricultural investigations the same scientific methods that he had found so important to success in other technical inquiries, and added an overflowing love for the pursuit in all its varied bearings. The younger Silliman wrote of him: "In point of time, originality, and ability, Dr. Dana stood deservedly first among scientific writers on agriculture in the United States."

The fourth edition of the Muck Manual was published in 1855. Its preface states that "the author is not an agriculturist; he does not assume the name even of agricultural chemist," and mentions his position at the works of the Merrimac Company. "While pursuing there," it continues, "during the years 1835, 1836, and 1837, researches on the action of cow dung in calico dyeing, he pushed his inquiries, as a recreation, during his few leisure hours, into the nature and action of manures and of soil. Conversation on these matters with the geological surveyor, and with the agricultural commissioner of Massachusetts, led to a correspondence between the parties, which partly appeared in the published reports on the geology and agriculture of Massachu-

setts. This induced some zealous and active citizens of Lowell to ask me to deliver a course of lectures on agricultural chemistry."

From the notes of these lectures the Muck Manual was prepared. "The work," Dr. Dana states further, "was favorably received at home and abroad, where a considerable portion was reprinted. It has passed through several editions, each being enlarged by the addition of new matter, to keep pace with the times. To the present edition is added an entire new chapter on bones and superphosphates of lime and alkalies. . . .

"One word respecting the title of my book. It is my own. I have neither begged, borrowed, nor stolen it. That last has been done by an English author, who seems to be ashamed, not of the act, but of the name he has filched from me, and so eases his conscience by apologizing for his 'homely title.' I shall not discredit my child by being ashamed of his name. It was good at the christening, and I trust will be thought respectable in manhood."

This edition of the Manual consists of nine chapters. In the first three the author tells the origin and nature of the inorganic ingredients of soil, and in the fourth he describes similarly the organic constituents. Dr. Dana vigorously combats the idea that the kind of rock underlying a district has anything to do with the character of the soil in that district, showing that the soil at any place is a mixture of materials, most of which have been brought from a distance. His full explanations of the several topics that he takes up are summarized in brief statements in a conspicuous type, which he puts forth as the first, second, third, etc., principles of agricultural chemistry. Among these are, "Rocks do not affect the vegetation which covers them"; "Soils contain enough of all the mineral elements to grow any crop" (but it is otherwise with organic constituents); "One base may be substituted for another in an equivalent proportion."

After describing the mutual action of these two classes of substances, he takes up the subject of manure. His chapter opens characteristically:

"The true farmer, no less a sage than the ancient orator who gave to action the first, second, and third place in eloquence, will answer, if it is asked him what is his first requisite, Manure. What second? Manure. What third? Manure. These answers are to be united. Action and manure are the first and last requisites in agriculture; and in the attempt to show what is the last, and how it acts, will be offered every inducement to action."

In the seventy-five pages of this chapter he describes the action of the manures of all domestic animals, also poudrette and certain waste materials valuable as fertilizers—wool washings, soot, bones, and spent lye from soapworks—and gives the chemical composition of nearly all.

In a chapter on artificial manures and irrigation, he deals with the use of swamp muck or peat, and tells how to make it a first-class fertilizer by the addition of soda ash or potash. There are a few pages on the physical properties of soils, and then the use of bones as a fertilizer is discussed. An appendix contains the results obtained by Dr. Andrew Nichols and others with the methods suggested by Dr. Dana.

Dr. Dana's geological knowledge was kept bright and increased by constant additions from the best and latest authorities. It aided him greatly in his agricultural researches. One of his courteous attentions to scientific visitors was an excursion to a traveling sand, in an outlying part of the city of Lowell, which was slowly and steadily advancing over arable land, converting it into a desert place. His long-sustained and minute observations threw strong light on the formation of sedimentary rock deposits, where currents of air rather than currents of water were the active agent, and made this field his own.

Dr. Dana died at his residence in Lowell, March 11, 1868, in consequence of a fall upon the ice at his own doorstep. In person he was tall and slender, with blue eyes, dark-brown hair, and a fair complexion. The expression of his countenance was intellectual and sympathetic. He was extremely witty, and, in his hours of relaxation from study, he entered with great zest into the pleasures of society, contributing his full share to the enjoyment of others. Even in his scientific writings his humor had some scope, and added a charm and zest to his descriptions that made them highly enjoyable and utterly inimitable.

Dr. Dana's first wife died in 1828 and he afterward married her sister, Miss Augusta Willard. James Jackson, the only son of Dr. Dana who survived childhood, when arrived at a suitable age received a commission in the United States army, and was afterward promoted to the rank of brigadier general. Dr. Dana also left three daughters.

THE question of the Asiatic origin or derivation of the Mexican and Central American monuments was recently presented to the Anthropological Institute of Great Britain and Ireland by Mr. Osbert H. Howarth. The speaker had become strongly of the opinion, after several years' observations of the works, that they were traceable to an Asiatic source, and he suggested that no subject in the whole range of antiquity is better worth careful study than the possible tracing of this splendid decorative art of Central America through the various countries of Asia with a view of determining whether or not any features of it could be positively identified with those which were known to exist in the earliest dynasties of Egypt. The probabilities that this was the fact were much stronger to his mind than any probability that the work arose from an independent source.

Correspondence.

OCCUPATIONS, PRIVILEGES, AND DUTIES OF WOMAN.

Editor Popular Science Monthly:

SIR: In consideration of the great interest I felt in an able article in your magazine for May, entitled Political Rights and Duties of Woman, I venture to express some of the thoughts which stirred me upon its perusal.

As I understood them, the writer's objections to the principle of woman suffrage can be classed under three general heads: objections as to the advisability or possibility of certain *occupations* for women; objections on the plea of the *privileges* which they already enjoy; and objections based on the idea of any change in the *character* of woman, as wife or mother.

It is to me a matter of surprise, as it must be to many, that the question of occupation should be considered as having any bearing whatsoever upon the subject. Although irrelevant, in a consideration of it, we must own the magnitude of the subject, as viewed not only in regard to woman but to all human kind. What class can take upon itself the responsibility of dictating to any other class what occupation it is or is not fitted to enter upon? It is easily seen that such a course would inevitably clip the wings of progress, as it is a tenet of its movement that the fittest survive, and the unusually gifted of one generation become in some degree the type of the next. Of one thing we may be sure, that no one performs tasks for which he is incapable, and those succeed who possess the faculties necessary to success. A majority of the walks of life have already been thrown open to women, so that the question of a new occupation opened for them by the right of ballot, narrows itself down to the one of officeseeking and officeholding. We on both sides of the question own, of course, that not all women will desire to enter upon this work, or to take advantage of their political rights, with any more alacrity than do a large share of men. There is one thing of which I may be permitted to feel sure, that if any woman succeeds in wresting office from a masculine candidate, or even in time reaches the White House, it will be by means of abilities which no one can gainsay, for, rather than that votes will be given her because she is a woman, the likelihood will be that she will wrest them from prejudice and conservatism in spite of that fact.

Every year is further proving that sex does not extend to intellect, and those who still hold to that belief will in the course of time have to blind their eyes to a great many facts in order to cherish it. The *grande passion* stirs men as well as women, and has power to inspire or weaken in the same degree.

Women are a privileged class, the paper says. It is true that few of us have any remembrance but of kindness and love from father, husband, and brother, and that very many of us have no great wrongs to bring to light, no troubles for which to claim redress. But it is hardly a privilege we enjoy to be loved, but rather mere justice, for do we not love also, and are we not in the same degree kind? These privileges, if we may call them so, which we mutually enjoy, I hardly think can be weakened by the ballot or by anything less than a sudden change and upheaval in the heart of the universe itself. It is a privilege, we read, that women enjoy in being "exempted from the perils, wounds, and deaths incident to war"; that the ballot now takes the place of the more savage conflict of war, and in this conflict, as in the other, women are exempt. You can't exempt women from fighting; five out of six fight. They fight, as does man, the forces of Nature, time, flesh, and the devil. Woman is in the thick of the world's conflict, whatever and wherever her arena, as are all human creatures, struggling with that friction which is progress, with those forces with which processes of evolution polish the stone for the workman, the soul for its soaring. The potter binds her soul to his wheel, as yours is bound, and what she desires is the same freedom, the same room for her wings.

Certainly, now that the conflict has been removed from the open field of war to the more peaceful one of the ballot, the old and earliest valid reason for dictating to her—her minimum of physical strength—has been removed. In no way of life, except in those old, savage, hand-to-hand struggles, is the race invariably to the physically strongest. Do the athletes, the prize fighters, bestow a privilege upon weaker men when they refrain from knocking them down? The necessary requisite, after all, is not brute strength, but *health*.

The question of character is a very large one, and moved by far too mysterious and wonderful forces to be decided by the ballot. It may be that many men are mistaken in their idea that the qualities of gentleness, amiability, obedience, or a small range of thought, make women better wives and mothers than human beings who are capable of justice, breadth of view, strength of judgment, and wide sympathies and interests.

Though we please men and men please us, if we keep pace, it will be rather through our higher qualities of mind, character, and heart, than by our lower nature, weaknesses, and faults; but, Heaven knows, both men and women will ever have a sufficient amount of the latter.

One word more. An often-quoted picture is this: The husband, the wage-earner, from morning until night busied with cares and labors, which leave him little time for culture or the more refining pleasures of life, while the wife and daughters are kept in idleness at home, entertaining themselves with gay or frivolous pastimes, expending the income which was earned at such cost. Would it not be better for custom to break its bonds a little and look about it, and allow those idle women occupation that would assist the father and develop their own dormant faculties? Would the sympathy in that home not be of a deeper and more enduring sort?

For women to be idle is no better than for men, and this waste of life and time, which so many are guilty of, at the cost of some overworked man, is a condition of things which cries to Heaven.

GRACE A. LUCE.

PREVENTING THE SPREAD OF DISEASE.

Editor Popular Science Monthly:

SIR: In the short article on Individual Communion Cups (Popular Science Monthly, July, 1896, page 425) it seemed to me that a good word has been spoken in season on a subject where, in the opinion of many Christian people who have been blessed with a scientific education, a pressing reform seems necessary.

The subject is one which attracted my attention some time ago in a serious way, and a knowledge of the danger incurred by communicants on several occasions made me realize the urgent necessity of a change in the custom prevailing in Protestant churches. In one of the instances referred to the officiating clergyman was known to be suffering from cancer of the mouth in an advanced stage; yet this circumstance did not deter him from partaking of the sacramental wine before passing the cup to the other communicants present.

In the Presbyterian and allied churches where the elements are received by the congregation while seated in the pews, the plan adopted by the Rev. Dr. Charles Herr appears to me admirable; but in the Episcopal Church, where the communicants advance to the altar, the best arrangement would be that each member should bring with him a flattened cup of silver or aluminum, with an appropriate design or inscription upon it, which could be fitted into a leather cover and carried in the pocket or attached to the case containing the prayer book, etc.

As the Founder of Christianity declared that his mission in this world was "not to destroy men's lives, but to save them," and as that is the noble aim toward which science also is working, I can but hope that the medical men who are interested in the welfare of the congregations to which they personally belong will feel it their duty to draw the attention of pastors and people very earnestly to this much-needed reform, and that the pastors themselves will lose no time in following the excellent example of the Rev. Dr. Charles Herr, of the First Presbyterian Church, Jersey City.

I am, with regard, faithfully yours,

JULIA F. CARVILL LEWIS.

HOTEL LANG, HEIDELBERG, *July* 10, 1896.

Editor's Table.

A BISHOP ON PROFESSOR HUXLEY.

IN many minds it is a settled conviction that the attitude of the Christian clergy toward science must necessarily be one of antagonism. There has been much, of course, in the history of the past to give countenance to such a view, and possibly the recent publication of President Andrew D. White's able and interesting volumes on The Warfare of Science with Theology may just now be doing something to strengthen and extend the impression. President White, however, it should be remembered, has not failed to make it clear that, in the general progress of intelligence, the clergy are more and more being led to take up a reasonable position in regard to the teachings of science; so that, on the whole, the antagonism of which he writes may be looked upon almost as a thing of the past.

It is a pleasure to find evidences of this in contemporary happenings. Some weeks ago a meeting was called in the town of Leeds, in England, to consider the question of raising subscriptions in aid of the Huxley Memorial Fund. Among those present was the Bishop of Ripon, Dr. Boyd Carpenter, who spoke strongly in support of the object of the meeting. He did not profess to share all Huxley's opinions; but that did not seem to him any reason why he should not bear testimony to the nobility of Huxley's life and the value of his services in the cause of science and of popular enlightenment. He recognized in Huxley a great man—"great by virtue of his devotion to science, great by virtue of that wide appreciativeness he brought to bear upon it, and great in the power of expounding it to others." He acknowledged that there were those—though, as he said, a diminishing number—who were disposed to "look askance at the progress of science." Their feeling was that science threatened to take away their faith—a faith that was bound up with their dearest hopes; but men were now "beginning to understand that it can not be in the nature of things that facts and truths will contradict those things that are nearest and dearest and most essential to their happiness." This perception, this conviction, the bishop holds to be faith in its highest form. "Because we are men," he says, "we claim it to be our privilege and our responsibility to follow truth wherever it leads us. It is *not* our duty to encourage a timidity which, if it were encouraged, could only lead to a fatal obscurantism. The progress of knowledge can only deepen and intensify our attachment to the things which are true, and the things which are true can not be out of harmony with the things around us."

These are brave and noble words, but the bishop was determined to be yet more precise, so that no one could misunderstand his meaning. He therefore continued: "Religious truth, in one sense, must always wait on scientific truth; and religious truth must often change its form at the bidding and on the information given it by scientific truth. I am not aware that in the history of scientific progress religion has ever lost; the precious jewels have always been restored to her in richer and nobler settings. Because I believe that the advancement of knowledge must be for the benefit of mankind, and could not in the long run be hostile to any of the things most precious to us, I stand here to-day to do honor to one who labored in the cause of the advancement of knowledge, and did so much to make it the heritage of all people."

Finally, this representative prelate bore testimony to Huxley's "truthfulness of character," for which he said he had "the profoundest admiration." As to Huxley's antagonism to Christianity, he said it was far more called out by the "unfortunate attitude of some who made themselves champions of Christianity, than by anything in the essential nature of the Christian religion." Huxley was not a man who would have wished to deprive any one of convictions that were a source to him of moral strength and comfort.

So far the Bishop of Ripon; and if a bishop can say these things, what is there to hinder that perfect reconciliation of science and religion which will give to both the best conditions for development? The fault to-day—so far as fault there is—is not wholly on the religious side. On that side we see the timidity which the bishop deprecates, and for himself repudiates; but on the other side

we see at times a disposition to exult in the scientific view of things as being fatal to all hopes and aspirations which do not rest on facts as material as those of physiology or mechanics. Man, however, has never yet confined himself to the circle of his material wants and satisfactions, nor is there any evidence that he is going to do so in the future. Individuals may choose to grovel, but the race, we may be sure, will, through all vicissitudes, strive after the highest life that is possible for it, and will not be turned away from its ideals simply because there are some who say that they do not know what an ideal is. The mission of science is a great and glorious one—far greater and more glorious than some who claim to speak for it have any conception of—but it has no mission, and no legitimate function, which would divorce it from the higher life of man or place it in antagonism to his deepest instincts and intuitions.

LORD KELVIN'S "FAILURE."

VERY needless, in our opinion, was the confession of failure which formed so prominent a feature in the speech delivered by Lord Kelvin (Sir William Thompson) on the occasion of the jubilee celebration tendered to him at the University of Glasgow in the month of June last. The eminent professor's words were as follows: "I might perhaps rightly feel pride in knowing that the University and city of Glasgow have conferred on me the great honor of holding this jubilee. . . . I do feel profoundly grateful. But when I think how infinitely little is all that I have done I can not feel pride; I only see the great kindness of my scientific comrades, and of all my friends, in crediting me for so much. One word characterizes the most strenuous of the efforts for the advancement of science that I have made during fifty-five years; that word is failure. I know no more of electric and magnetic force, or of the relation between ether, electricity, and ponderable matter, or of chemical affinity, than I knew and tried to teach to my students of natural philosophy fifty years ago in my first session as professor. Something of sadness must come of failure, but . . . what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these fifty years have so abounded!"

Now, with all respect and deference to one of the very greatest scientific men of the century, we venture to affirm that Lord Kelvin here strikes a false note; we even go so far as to say that he indulges in false sentiment. If the labors of his life had been specifically devoted to finding out the essential nature of electric and magnetic force, at divining some ultimate mystery of Nature, we could understand his speaking of "failure" in the way he does; but seeing that nothing is more certain than that no such aim or ambition was present to his mind, but that his efforts were devoted to just those "discoveries by observation and experiment on the properties of matter" and those "applications of science to the use of mankind," in which he acknowledges the last fifty years to have been most fruitful; and considering that his distinguished success in that field of labor is recognized by the whole world, and was the cause and justification of the gathering held in his honor, we must say that the word "failure" in connection with such a career seems to us singularly out of place. One of his brother *savants*, Prof. A. Gray,

speaks of this "humble confession" as "characteristic of the man," but we do not find this view of the matter satisfactory. The question is a simple one. In what does scientific success or failure consist? Either word should have its own distinct meaning. If Lord Kelvin is to be counted among those who have failed, whom shall we put down as having succeeded? Sir Isaac Newton? But Sir Isaac Newton did not "penetrate the mystery of the constitution of matter," to use Prof. Gray's expression, any more than Lord Kelvin has done. He provided a formula which expressed one kind of action exerted by bodies on one another, but he gave no clew to the nature of gravitation. He worked out a great number of intricate questions in mathematical astronomy, but none of his solutions do more than correlate phenomena. We may admit him to have been a greater genius than Lord Kelvin; but that would not justify us in saying that the labors of the latter bore the stamp of failure. Each was successful in a high degree in what constitutes the true work of the scientific investigator, the reduction of phenomena to law: if either aimed at doing more than this he failed, but the failure was not a scientific one; it was the inevitable failure of the human mind in striving to transcend the region of cause and effect and the relation of subject and object.

We have only to consider for a moment in order to see and feel that so long as any one phenomenon or condition is recognized as the *cause* of any other, the secret of the universe has not been penetrated—we are as much in the presence of "mystery" as if we had a thousand or a thousand thousand separate causes to deal with. Our minds are so constituted that, while our whole consciousness depends on the recognition of difference, we have a constant craving for unification; we would fain, as it were, destroy that by which we live. It is the baffled desire for unification that gives us the sense of mystery; and when Lord Kelvin talks of "failure" he means no more than that he has not succeeded in merging effects into causes and causes into effects, and making a unity in which thought itself would disappear.

We think ourselves that the word is unfortunately used; for there are those who are on the watch to catch every confession or expression of weakness on the part of science. "The foremost physicist of the age," these will say, "confesses that all his labors of fifty years may be summed up in the one word 'failure'; that he knows no more to-day about the deeper questions of science than he did fifty years ago. Is it not plain that the Mosaic account of creation must be correct in all its details, and that men in general can not do better than submit themselves to ecclesiastical authority?" Perhaps the deductions may not be expressed in this broad and simple way; but such at least will be the drift of the argument. And yet the truth is that science is all the time doing all that it can reasonably be expected to do—revealing the order and relations of phenomena, detecting, by means of approved appliances, operations of Nature which had eluded previous observation and which must ever have eluded the unaided senses of man, opening wider and wider regions to human thought, and conferring upon mankind an ever-increasing mastery of the laws and resources of the physical world. It does all this by the aid of symbolical language and working hypotheses—in other words, by a kind of algebra of its own; and the utmost fault its critics can find with it is

that it can not in some way express the absolute reality of things without the use of symbols or formulæ. Well, science must share that reproach with the human intellect of which it is the product and manifestation; but we do not see why the reproach should be brought against it by its own most shining representatives. Rather might Lord Kelvin have said: "Science in my day has been most prolific of blessing to mankind; it is proceeding apace with its appointed task of enabling men to understand *for practical purposes* the world in which they live, and what shall be the limit to its achievements in that direction no one can foretell. As to the 'riddle of the universe,' of which we sometimes hear, that lies beyond its ken: only when thought ceases to be conditioned will that riddle—not be read, but—disappear."

Scientific Literature.

SPECIAL BOOKS.

PROF. GIDDINGS'S *Principles of Sociology* * is a very opportune book. A disposition has been manifesting itself for several years to call almost everything sociology. Most of the popular journals now have a department of sociology, into which they put everything going on in society that does not clearly belong to party politics. All the "advanced" social questions are being discussed under the head of sociology. Especially are so classed the zealous utterances of a large group of well-meaning persons who believe something ought to be done for the less favored members of society. In this class are great numbers of warm-hearted clergymen who think they see in the teachings of the Master a warrant for preaching wholesale social reforms, and this they call "Christian sociology." Add to this the thousand problems of charity, philanthropy, and general social betterment of the condition of the poor, and we have already in the infancy even of the word *sociology* a burden of unscientific and half charlatanic applications of it that threaten to sink it as deeply into obloquy and contempt as a similar procedure sunk that etymologically far better word, *phrenology*, half a century ago.

Of course, Mr. Herbert Spencer's great work, now happily completed, on the Principles of Sociology, not to speak of his Descriptive Sociology, and his other works on that subject, would have sufficed to save it from such a fate, but as it is in America that the tendencies above pointed out are most pronounced, so there was needed in America a standard work that should teach, so far as known, what sociology is, and serve in some degree to stem the tide of degeneration. Prof. Giddings's book to a considerable extent supplies this need. Those who, in the main justly, complain that it ignores all questions of social progress, that it treats wholly of what *is*, and not at all of what *ought to be*, should not forget the peculiar conditions under which it was written, as briefly described above. Whether Prof.

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* The Principles of Sociology. By Franklin Henry Giddings, M. A., Professor of Sociology in Columbia University. Pp. xvi + 476, 8vo. New York and London: Macmillan & Co. Price, $3.

Giddings believes in the possibility of a dynamic science of society or not, he was fully justified, in view of the circumstances, in confining himself strictly, as he has done, to the statical and historical aspects of sociology. Moreover, there was the less need of departing from this line, as there is in this country a school of dynamic sociologists, no more sanguine than he of immediate reforms, but working along the lines of social mechanics, to whom that aspect of the question may properly be left.

In view of this very youth of the science, and especially of the confusion of ideas as to what sociology means, it will be profitable at the outset to examine Prof. Giddings's definitions. The first is given on pages 5 and 6, where he says: "It is not too much to claim that we have now, at length, a sociology, which may be defined as the systematic description and explanation of society viewed as a whole. It is the general science of social phenomena." He recognizes, however, that social phenomena are chiefly distinguished from all other classes by the psychic element that enters into them, and on page 25 he rather sententiously remarks that "psychology is the science of the association of ideas. Sociology is the science of the association of minds." This he qualifies on the next page in the following form: "Psychology thus is the science of the elements and of the genesis of mental phenomena, as determined by physical and organic relations. Sociology is the science of mental phenomena in their higher complications and reactions, and of the constructive evolution of a social medium, through which the adaptations of life and its environment become reciprocal."

One of the most difficult questions has been to distinguish sociology as a science from what have been called the "special social sciences"—i. e., the several groups of phenomena obviously social, which, whatever sociology may be, must stand in some intimate relation to it. On this Prof. Giddings, pages 30, 31, makes the following observations:

"Clear thinking and a discriminating use of terms will create order from the confusion and will establish sociology in its rightful place, where it can no longer encroach on the territory of other sciences or be crowded out of the field by them. Sociology is a general social science, but a general science is not necessarily a group of sciences. No doubt the word will continue to be used as a short term for the social sciences taken collectively. . . . By methods of sound logic, and with guidance from the history of other sciences, sociology can be definitely marked off from the special social sciences." And on page 33 he adds: "Therefore, while sociology in the broadest sense of the word is the comprehensive science of society, coextensive with the entire field of the special social sciences, in a narrower sense and for purposes of university study and of general exposition it may be defined as the science of social elements and first principles."

Finally, on page 419, he gives the following definition:

"Sociology is an interpretation of social phenomena in terms of psychical, organic adjustment, natural selection, and the conservation of energy. . . . It is strictly an explanatory science, fortifying induction by deduction, and referring effects to veritable causes."

Although these various definitions are somewhat bewildering if not inconsistent, they do nevertheless afford some idea of what sociology is, and it is clear that they give no countenance to the practice of making it a general receptacle for all sorts of reform programmes and theories of social re-

generation. In fact, with Prof. Giddings, as with Spencer, sociology is the study of society as it is and as it has been; also, perhaps, so far as a knowledge of its laws render prediction possible, as it is likely to be in the future; but not at all a study of what it ought to be, much less an attempt to lay down rules for its improvement.

Although Prof. Giddings has followed Spencer very closely in his general ideas of sociology, still he thinks he has discovered one very fundamental principle that is entirely new, and upon which he attempts to build the entire science. This principle he calls the "consciousness of kind"—i. e., the fact that men recognize their like, and that this natural affinity makes it possible for them to crystallize into social groups. Of course, he finds the principle running down through the entire animal series, and he commits the fallacy of regarding this as the highest proof of its sociological importance. In fact, he has seized upon a well-known and important biological principle, and, as may be done with so many others, he has successfully applied it in various departments of social life. It has doubtless helped him in dealing with the difficult question of the origin of human association, to which he has given special attention.

The work is divided into four books, the first of which deals with the theory, the second with the structure, the third with the evolution, and the fourth with the causes of society. Space will only permit a brief reference to Book III, on the Historical Evolution of Society, which is not only the most important department of the work, but is the most ably treated. The general subdivision was briefly outlined in an earlier paper on the Theory of Sociology. It is into zoögenic, anthropogenic, ethnogenic, and demogenic association, to each of which a chapter is devoted. The treatment of zoögenic association is too brief, but if properly expanded it would form an important introduction. To the two chapters on anthropogenic and ethnogenic association too great praise can not be bestowed. Although somewhat trite subjects after all that has been written by Tylor, Spencer, Morgan, McLennan, and the rest, Prof. Giddings has succeeded in so organizing, methodizing, and condensing this immense mass of data as to render it not merely interesting and instructive, but even fascinating, and to enable the reader to acquire in small compass practically all of importance that is contained in so many large volumes.

The chapter on Demogenic Association, which in a work on sociology should have been the *pièce de résistance*, is less ably written and should have been expanded and improved. But the reader will see for himself what its defects are, and will be able to a great extent to supply them. This department of the work, however, taken as a whole, possesses exceptional merit.

It will be charitable to the author to refrain from discussing Book IV, on Social Process, Law, and Cause. Much of it is an attempt to apply Spencer's First Principles to social phenomena, in which the author is generally unsuccessful. There are, however, some very good suggestions under the head of Social Choices, which we can commend to the reader.

Mr. *Schoenhof's* latest contribution to the Questions of the Day Series deals with the economic subject that is uppermost in this country at present—namely, how far prices can be raised by an abundance of cheap cur-

rency.* There are few important effects that do not flow from mixed causes, and Mr. Schoenhof makes it plain that the fixing of prices for commodities is no exception. Besides the condition of the currency he names wages, profit rates, expense of distribution, taxation, science and invention, interest, transportation, and monopolies as affecting prices. His views, as expressed in former writings, having been criticised severely, he has been led to examine for this volume the prices of the period anterior to the discovery of the American silver mines and to carry the comparison down to the present time. He is thereby confirmed in the opinion that the *quantity* of money in circulation has little influence on prices, but that its *quality* is more important. Further, "that price increase brought about by the issue of depreciated currency or other inflating causes has always acted detrimentally to the interests of the working classes." In the early chapters he gives statistics of the output of gold and silver from the mines of the world from 1492 to 1894, and the value ratios of gold to silver at various times, showing that the latter were not affected by the relative quantities of the two metals in existence. He maintains that silver has become cheapened because it has been left behind as a money metal by advancing civilization. The main part of the volume consists of a history of prices in England, France, and Germany from the middle ages to the present time, combined with which there is considerable history of European currency. Following this are four chapters in which the influence of what the author regards as the true price-making factors is set forth in some detail. Mr. Schoenhof is an expert in economic research, and his positions are all supported by statistics and historical facts.

GENERAL NOTICES.

We venture to say that no writer has made the Alps more attractive to thoughtful persons than Prof. *Tyndall* has. His evident enjoyment of the physical and mental exhilaration afforded by scaling the icy peaks, his full appreciation of the beauties of the mountains, of which his trained observation enabled him to see more than the mere tourist, and the simplicity and vividness of his style of writing combine to give the accounts of his climbs the fascination of tales of adventure. His *Glaciers of the Alps* † was first published in 1860, and for many years past has been out of print. It is divided into two parts: the first, chiefly narrative, describes his ascents and traverses of the mountains in 1856–'59, which included two ascents of Mont Blanc, two of Monte Rosa, one of the Finsteraarhorn, a winter expedition to the Mer de Glace, and many minor climbs; the second, chiefly scientific, contains his observations on the Alpine ice and his discussions of the glacial theories current when they were made. In the narrative part the human element is delightfully conspicuous. Profs. Huxley and Ramsay were his companions in some expeditions, and to the reader who knows both them and the author only as prominent English scientists it is supremely comic to read of Tyndall being buried in hay by his guide for a night's rest in the loft of a cheese-maker's cowhouse, or of Huxley lighting and holding wax matches one after another to furnish light for the others to get an early breakfast by. These experiences, too, are not without their spice of danger, and the author makes it plain that the rocks and ice are not to be trifled with.

The second part of the book is introduced by three chapters explaining the nature of light and heat, after which the phenomena of ice exhibited in glaciers are discussed at

* A History of Money and Prices. By J. Schoenhof. Pp. 352, 12mo. New York and London: G. P. Putnam's Sons. Price, $1.50.

† The Glaciers of the Alps. By John Tyndall. Pp. 445, 12mo. London, New York, and Bombay: Longmans, Green & Co. Price, 10*s.* 6*d.*; $2.50.

length. This discussion contains much interesting matter bearing upon the history of glacial theory, the subject at the time Tyndall wrote being in heated controversy. In order that the pages now reproduced might contain nothing touching the views of others which Prof. Tyndall might have wished at the present time to alter or omit, his widow submitted the historical parts to Lord Kelvin, who assures her that, in his opinion, "the statements on controversial points in this beautiful and interesting book of your husband's are all thoroughly courteous and considerate of feelings, and have been felt to be so by those whose views were contested or criticised in them." The beginning of Tyndall's study of glaciers proceeded from a discourse on slaty cleavage which he delivered at the Royal Institution, in June, 1856. This discourse is appended to the volume. Some sixty simple illustrations aid in making clear the text.

Dr. *H. Holbrook Curtis's* work on *Voice Building and Tone Placing** relates to the singing voice. The author has invented a method of tone exercises for overcoming serious affections of the vocal cords which has been used satisfactorily by the most renowned singers, and he furnishes here an exposition of the physiological principles, and the elementary laws of sound and music, on which it is based. The chapters on anatomy and respiration are intended to be of value to the physician as well as to the student of singing; and for that reason also the subject of the vibration of the vocal cords has been considered in a way in which it is not entered into in any other work. The author's theory that the overtones introduced by the proper method of placing tones in the facial resonators induce a new plan of vibration of the vocal cords has recently been verified by the investigations of Prof. Oertel, of Munich, and several of his experiments have been introduced to explain the true plan of vibration of the cords as seen in the stroboscope. The author has also tried, with the aid of these experiments, to elucidate his theory as to the removal of "singers' nodules" by tone exercises in a scientific way. The general scheme of the building of the voice, in accordance with the author's theory of tone placing, is appended for the benefit of teachers and students. The book is the result of a vast experience with singers. The ideas have been put together in a concise and simple way, without any attempt at elaboration of style. The closing chapter, on Voice Figures, in which the vibrations are translated into pictures of great variety and beauty, has more than a physiological or acoustic interest. It is a revelation of the grace and æsthetic charm with which Nature's processes are found to be invested, whenever we are able to recognize them.

In his discussion of the *Primary Factors of Organic Evolution*,* Prof. *Cope* attempts to select from the mass of facts accumulated by biologists those which, in his opinion, throw a clear light on the problem of organic evolution. As the actual lines of descent can be finally demonstrated chiefly from paleontological research, a large part of his evidence is drawn from that source. Another reason for preferring the paleontological evidence is that Darwin and his school have drawn their evidence from œcology and Weismann and writers of his type from embryology, leaving the paleontological field less worked. The mass of facts recently brought to light in the field of paleontology, especially in the United States, remained to be presented, and the evidence they contain to be interwoven with that derived from the sources mentioned. The view is accepted, to which many zoölogists are now inclined, that the factors of evolution which were first clearly formulated by Lamarck are really such; and the research has proceeded on the assumption that every variation in the characteristics of organic beings, however slight, has a direct efficient cause. Any theory of evolution which omits the explanation of the causes of variations, Prof. Cope holds, is faulty at the basis. Hence the theory of selection can not answer the question asked, although it embraces an important factor in evolution. The subject is considered under the several headings of

* Voice Building and Tone Placing. By H. Holbrook Curtis, M. D. Pp. 215, 12mo. New York: D. Appleton & Co. Price, $2.

* The Primary Factors of Organic Evolution. By E. D. Cope, Ph. D. Pp. 547, 12mo. Chicago: Open Court Publishing Company. Price, $2.

The Nature of Variation, The Causes of Variation (including Natural Selection), and The Inheritance of Variation, with chapters on The Energy of Evolution, The Function of Consciousness, and The Opinions of Neo-Lamarckians.

In view of the recent successful trial of Prof. Langley's flying machine and the encouraging results obtained by Lilienthal in Germany, the *Aëronautical Annual** for 1896 is of especial interest. It consists of a number of disconnected papers, from men prominent in aëronautical matters, on the various aspects of the subject. The first article is one by Otto Lilienthal, entitled Practical Experiments for the Development of Human Flight, in which he describes his recent experiments and pictures the apparatus. The editor has an article on Wheeling and Flying, in which he calls attention to the analogy between the slow development of the two methods of locomotion. A long paper by Hiram S. Maxim on Natural and Artificial Flight, which is said to be made up of abstracts from an unpublished work, and to contain the results of Mr. Maxim's latest thought, comes next. An article by Octave Chanute, on Sailing Flight, is prefaced by a short biographical sketch and portrait of the author. This is followed by a three-page contribution on How a Bird Soars, by Prof. W. H. Pickering, in which a mechanical explanation of this apparent paradox is offered. There are a number of other interesting papers, several of which are on Kites and Kite-flying, and a short bibliography of aëronautics. Good illustrations are quite numerous.

The last of the Technological Handbooks to reach us is No. 10, *Gas Manufacture*, by *J. Hornby*. It is intended as a student's manual, and was especially arranged with reference to the examinations of the city and guilds of London (England) Institute. The author opens the book with a brief consideration of the various kinds of coal and their value for gas-making purposes. The following chapters and the main portion of the book treat of the technical processes and the special apparatus used in manufacturing, purifying, and testing the gas. The final chapters are devoted to special topics, such as the laying of mains and surface pipes, the construction of gas meters, gas burners, and the composition of coal gas (London: George Bell & Sons, 5s.; New York: Macmillan & Co., $1.50).

Concrete Geometry for beginners, by *A. R. Hornbrook*, is an introduction to the study of geometry by means of object lessons. The author very truly says that the "universal demand of the learning mind is for the concrete and the particular as stepping stones to the abstract and the general." He has found in the course of his teaching that a student might be able to recite glibly demonstration after demonstration of geometric principles and still be totally at a loss when asked to make simple applications of them, this condition being evidently due to the inability of the student to picture the physical quantities on which he was working. The text consists of an apparently carefully selected and graded series of simple problems for fixing in the beginner's mind the elementary facts of geometry from lines and angles to squares and cubes. After each two or three chapters there is a "cumulative review" for testing the student's grasp of the new principles and combinations (American Book Company, 75 cents).

The *Home Study Review*, published by the Home Study Association at Ann Arbor, Mich. (15 cents; $1.25 per annum), is designed to offer to those who can not attend a school or college an opportunity of pursuing studies at home under direction. The first course is to include the following subjects: History, German, biology, rhetoric, English literature, and a commercial course. While it is to be hoped that the publication may prove useful, the scheme does not seem promising.

The *Transactions of the American Microscopical Society* for 1895, Volume XVII, contains the usual number of valuable papers, which are, however, most of them so technical as to have little interest except for the biologist or microscopist. Among the few papers of general interest is one by Simon Henry Gage, the president, on The Processes of Life revealed by the Microscope: A Plea for Physiological Histology,

* The Aëronautical Annual, 1896, No. 2. Edited by James Means. Pp. 128, 800. Boston: W. B. Clarke & Co.; London: William Wesley & Son. Price, $1.

in which he strongly urges that in studying an organism or its tissues the investigator to gain certain knowledge must know the age, health, state of nervous, muscular, and digestive activity; in fact, all that it is possible to find out about the processes of life that are going on and have gone on when the study is made.

The *Thirteenth Annual Report of the New York State Agricultural Experiment Station* contains, as do all these publications, the results of much valuable experimental work. Among the papers of especial interest in the present volume may be mentioned the following: The Individuality of the Cow as influencing Offspring; The Relation of Sex in Thoroughbred Calves; Proximate Constituents of the Dry Matter of Food; The Relation of Fat in Food to Fat in Milk, and Twin Calves; Alfalfa Forage for Milch Cows; and A Detailed Comparison of the Different Breeds of Dairy Cows with reference to the Production of Cream and Butter.

The second number in the Section of History and Economics of the Leland Stanford Junior publications consists of a monograph on the *Official Relations between the United States and the Sioux Indians*, by *Lucy E. Textor*. The author begins her history with the formation of the republic, and traces in detail the various forms of legislation and "agencies" by which we have attempted to regulate and protect the Indians. The work seems carefully done, and, as the editor says, each special investigation of this sort is important as an advance toward that "general ideal history of the United States" which we still lack.

School Interests and Duties, developed from Page's Mutual Duties of Parents and Teachers, from various Public Reports and Documents, and from the Bulletins of the National Bureau of Education, by *Robert M. King* (American Book Company, $1), is connected with Mr. Page's address by the address having been a powerful agent in the advancement of the schools to their present position, and having partly laid the foundations of that advance. In the meantime new factors have come into prominence in school affairs—chiefly the institution of school boards, directors, trustees, etc., to take the place of citizens at large in the direct management of the schools; and further, the vast extension of the subjects to be dealt with. This book has been prepared with a view to bringing down to date the doctrine of co-operation in school interests, "with all that it implies of enlightened, harmonious, and effective work in the interests of popular education," and the thoughts of numerous recent writers are quoted in connection with the discussion. It deals with such subjects as the duties of parents, of teachers, and of school officers, school architecture, hygiene, libraries, morals, etiquette, celebrations and observances, the use of the dictionary, the teachers' institute, reading circles, and the teacher's relation to public opinion. In conclusion, a series of outlines of reading-circle work is given.

The advantages of vertical penmanship have been so widely recognized that every publisher of writing-books now has to have a vertical series. A vertical style of the well-known Spencerian penmanship has been prepared, and in the *Shorter Course* this style is presented in seven small square books. Directions with cuts showing positions are given on the inside pages of the cover. (American Book Company, 6 cents each.)

The distinguishing features of a new elementary text-book on *Algebra*, by *Lyman Hall*, are stated in the preface as, first, preserving the familiar methods of arithmetic as far as possible in the first chapters, in order to convince the student that algebra is merely an extension of the mathematical knowledge he already possesses; second, review examples and questions throughout the book which will help him to master following chapters and prepare him to pass from this to a higher treatise without a formal review. (American Book Company, $1.)

In his recent text-book on *American Literature*, Prof. *Brander Matthews* makes fifteen authors of the United States stand out prominently by giving each a chapter and providing them a background of colonial and other writers whose works are of less general interest. Portraits of most of the authors mentioned are given, together with pictures of the birthplace, and sometimes of the later residence, of the more prominent, and facsimiles of their manuscript. Each

chapter is followed by references for reading and a few suggestive questions, while at the end of the book is a chronology of American literature down to 1896. (American Book Company, $1.)

Under the title *The Glory of the Garden*, a collection of odes and sonnets has been printed by *William V. Byars*, with an appended essay on The Horatian Ode and the Tuscan Sonnet. The recent discovery—or rather recovery—which Mr. Byars claims to have made, of the principle of melody governing the verse of the great classical poets from Homer to Horace and Virgil was due to a partial recovery of the accent of the classical languages, effected through a comparison of the sounds of modern Greek and Italian with ancient Greek and Latin. A modern Greek, a graduate of the High School at Athens, was employed to read Homer aloud, for comparison with the Tuscan of Dante read aloud by an educated Italian. The verse of Béranger read aloud by a Frenchman was also compared with the lyrics of Horace, but it was to the comparison of the melody of Dante with the rhythm of Homer, when read by its accents, that the recovery of classical accent is chiefly due. When classical verse was read with an accent rather lower than that of modern French, and with the downward value of the grave accent equal to the upward value of the acute, the surprising discovery was made that in both Horace and Homer the melody of the verse depended on the systematic use of rhyme—not of regular end rhyme as in modern verse, but of line and staff rhyme, regulated by a method not unlike that used by the old Norse poets. The discovery of Bentley, that the verse of Virgil and Horace is read by "synaphea," without regard to its verse endings, is thus shown to be of the highest importance.

Vol. I, No. 1, of the *A. I. C. P. Notes*, which interpreted means American Association for Improving the Condition of the Poor, has recently reached us. Its space is all given to an account of the utilization of vacant city lots for the purpose of giving the unemployed an opportunity for earning their own living. During recent years several attempts of a similar nature have been made, some of them being attended with considerable success, notably the Detroit vacant city lot farms, which were inaugurated by Mayor Pingree. The attempt in New York is fully described in the above pamphlet, and, while it has not thus far been a remarkable success, still its officers are very enthusiastic and hopeful for the future. Subscriptions are requested. (105 East Twenty-second Street, New York city.)

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Fragments of Science.

X Rays in Surgery.—Considerable advance has been made during the past few months in the application of the X ray to surgical diagnosis, and it seems fairly certain now that the trunk with its contents, as well as the extremities, may be examined by the use of this agent. A recent article in the American Journal of the Medical Sciences, by W. W. Keen, includes some remarkably clear reproductions of X-ray pictures, one of which shows very beautifully all the bones of the trunk. Among much interesting matter the article contains a suggestion which deserves at least a trial. The difficulty with the present pictures is that an exposure which is long enough to show the bones blots out all detail in the soft parts. Dr. Keen suggests the use of a number of superposed paper films. The X rays will act almost equally on them all, and by withdrawing one at a time at short intervals a series of pictures of the object will be obtained which should show all the required detail. An important improvement in the Röntgen apparatus is said to have been made by the General Electrical Company of

Berlin, by means of which the interior of the head and chest may be directly examined by means of the fluorescent screen, even the action of the heart and lungs being discernible. A demonstration was recently given by Dr. Oscar Levy at the Lancet offices, and was reported as very successful. The vacuum tube employed contained two concave electrodes, midway between which was situated a platinum disk in a plane of 45°. One or other of the electrodes, according to which gives the best results, is connected up, by means of a wire, to this disk, the wires of the coil being attached to the concave electrodes, so that the anode is duplicated. The screen employed measured about ten by eighteen inches, and consisted of small crystals of platinocyanide of barium.

The Present Business Depression.—An article in the July Engineering Magazine, by Edward Atkinson, attributes the present business depression to the Bland and Sherman acts, "under which the demand debt of the United States was increased by an issue of notes or promises to pay by nearly five hundred million dollars for the purchase of silver bullion, which, when coined into dollars at 16 to 1, is bad money. We may easily trace the cause of our present bad conditions to the enforced use of bad money." He presents the conditions under the free coinage of silver in a somewhat new light, and makes it obvious that, instead of giving the poor man an undue advantage, it will increase the opportunities of the rich, and instead of benefiting the United States it will place her at a disadvantage and make her mints common dumping ground for all the depreciated silver of the world. He says: "The advocates of the free coinage of silver dollars of full legal tender propose to enable the bankers of Europe to gather in the silver bullion of the world, of which the market value is now sixty-eight cents per ounce, to send it to our mints to be coined without charge, and then to force it upon our farmers, wage-earners, and other persons at $1.29½ an ounce, thus cheating them out of about half their dues for the benefit of two privileged classes—the silver miners of the West and the foreign bankers and their agents of the East." This tendency on the part of politicians to attempt by legislation to counter the result of natural forces is always eventually quite futile, and, as in the present case, is usually fruitful of much suffering and anxiety in the business world. The secondary place which silver now occupies as a money metal is entirely a natural growth due to causes over which statesmen and governments have no control, and the United States, even if she succeeds in legalizing an unlimited coinage of fifty-cent silver dollars, will simply, by purely artificial means, be substituting an unnatural, unwieldy, and limited silver unit of value for the compact, convenient, and widely used gold unit. Not only would the resulting currency be much less satisfactory than our present one, but the change from one to the other would almost surely involve serious business troubles.

The Expert Witness.—Considerable attention is being given by the more thoughtful newspapers and some scientific journals to the disreputable episodes which almost invariably occur when experts are called on for testimony before the courts. The present custom, which permits each side to call in its own expert and pay him for his testimony, is calculated to produce anything but *expert* testimony, unless the term expert applies to manipulation of facts to suit his client's case. It would be about as conducive to justice if each side were allowed to retain and pay a judge and jury of its own. In fact, the practice is so obviously calculated to defeat instead of aid the ends of justice that it is difficult to see how it ever originated. The mere fact that a witness is employed and paid by the defendant or plaintiff unconsciously enrolls him on that side, and there are few experts whose testimony is not modified by such an arrangement. This custom has led so often to a flat contradiction regarding facts between opposing authorities that the general public has lost confidence in such testimony. This is, of course, very unfortunate, as it is beyond question that a man who has devoted his life to a study, for instance, of poisons and their effects on the body, is in a better position to judge of the probabilities in a given case than the ordinary layman or physician. Under a system where the expert is called by the court no question of bias could be

raised, and science would not be disgraced from time to time by those who are willing to trade on their scientific reputation.

The Competiton Fetich in Education.—"The dying out of the distinguished school of naturalists which this country once produced, and which culminated in Darwin, is a fact which scarcely admits of dispute," says W. T. Thiselton-Dyer in a recent article in Nature. "English naturalists of the generation which is now passing away have belonged to two groups. Some have been born to wealth, some to poverty. Class prejudice was against the one, means of livelihood against the other. The richer disciples of our art seem now to have gone irretrievably and to have no successors. The poorer have changed their tone. They tend to treat science as a career like the civil service." Mr. Thiselton-Dyer quotes a friend who believes the cause of this degeneration in the ideals of scientific workers to be due to the system of constant competitive trials, which it seems, in England as well as in the United States, pervades everything in the schools from Greek to athletics, and which completely overshadows the real reason and point for going to school. "This remarkable system begins, the masters of this and other schools told me, at about eight years old. There is no time to learn, to think, or observe. The boys must beat some other school in tennis or football, or must beat some one else in the history of the Punic wars. . . . The great object of education appears to be to have every boy competing for something absolutely useless to him in later life." This latter, of course, is something of an overstatement; but the indiscriminate encouragement of rivalry and subsidizing of the winner, without reference to the value of the knowledge which the success implies, has been steadily at work in our universities for some years, and has been one of the principal factors in bringing the college graduate into disrepute as an unpractical and many times really ignorant man. He quite loses his bearings when launched forth on the actual sea of life, judges questions from the limited standpoint of the local horizon which his *alma mater* has provided for him, and, worst of all, being a college graduate, is rather inclined to be supercilious at any suggestion that perhaps there are a few small scraps of knowledge which he is not yet master of. There have, however, quite recently been signs of reaction against the competitive system—at any rate, in athletics—and it is to be earnestly hoped that this reaction will extend itself to the whole curriculum. We may then, perhaps, expect to see an educational system based on the requirements of everyday life, and the graduates of our highest educational institutions taking their full share in the business and politics of the country.

A Natural Botanical Garden.—A somewhat curiously distributed flora is described as existing in the island of Sakhalin, at the northernmost end of the Japanese group. Its geological structure resembles that of Siberia much more nearly than that of Japan. Volcanoes, which are such a characteristic feature of Japan, are entirely wanting here, and the three parallel chains of mountains which form the backbone of the island are composed of Jurassic slate, Cretaceous strata, and Tertiary limestone, being similar in formation to those of Siberia. The mountains reach an average elevation of six thousand to seven thousand feet, and this, combined with the abnormal climatic conditions of the island, give rise to a very varied vegetable life. Although it lies between the latitudes of Trieste and Hamburg, its conditions of life are almost polar. Bathed by two cold marine currents, it is exposed without protection in winter to the cold northwest winds of the east Siberian anticyclone, and an abnormally cold winter as well as summer results. At sea level snow lies in open sunny spots even in May. Snowfalls occur to the end of May. Owing to the cold currents which surround the island, distance from the coast plays an important part in determining vegetable growth, and gives rise to anomalies perhaps observable in no other portion of the earth's surface. In Siberia and in central Europe it has many times been noticed that during the winter cold the mountain summits are much warmer than the plains. The same is true in Sakhalin. The cold and heavy winter's air collects in the lower regions, while above the mountain heights enjoy the warmer sea breeze. But even in summer, owing to the cold ocean

currents, the mountains display abnormal temperature conditions; and while an arctic vegetation prevails on the seashore, forests with subtropical Japanese species occur at a certain elevation, and only on the highest summits does the forest again give place to arctic plants. The principal trees of the forest are pines, firs, and Siberian larches. The growth is very rapid and the struggle for existence severe, so that many trees are killed; the dead trees still standing and others fallen are so numerous as to make these forests almost impassable. On the west side of the island maples, birches, and large numbers of mountain ashes abound. At a certain height, especially in the more interior portions of the island, quite a sudden change to subtropical trees occurs. High bushes of Japanese *Flex crenata*, stems of bamboo as high as a man, bush-like *vaccinium*, fine hydrangeas, and the colossal leaves of *Araliaceæ* and *Petasites* make their appearance, and form an almost Indian jungle beneath the conifers of the far north. On the highest summits the forest disappears and is replaced by dwarf firs, *Cembra pumila*, and evergreen stretches of *Empetrum nigrum*. Where the seashore is flat and exposed to the wind trees are entirely wanting, and an approximation to the arctic tundras prevails. The true tundra region, however, is not on the seashore, but in the great longitudinal valleys, where a regular polar tundra, with frozen soil, peat bogs, and arctic vegetation, occurs. The banks of the streams are, however, clothed with luxuriant vegetation. At a distance of a quarter to a half mile from the river bank the peat bog gives place to a charming meadow of *calamagrostis* grasses, with park-like groups of birches, poplars, willows, etc., and an exuberant bush vegetation.

Do the Poor hate the Rich?—An interesting discussion is going on in the Contemporary Review between Mr. Hobson and Mr. W. H. Mallock, as to whether the poor hate the rich. Mr. Hobson affirms it and Mr. Mallock denies it. An impression that they do prevails largely among certain classes of philanthropists and socialists. The London Spectator, reviewing the discussion, thinks that, however it may be in the continental countries of Europe, this is not the case in England and among Americans of English descent. The immense majority of these accept differences in pecuniary conditions as part of the order of things, and rather approve them as affording incentives for ambition and grounds for hope. They do not hate the rich, because they would all like to be rich, and hope by some means some day to become so. They rather regard them as sources of benefit to the community, as persons who will keep up the standard of living, and who increase the general mass of opportunities. They will welcome the settling of a wealthy man among them, because he will spend money. Those may hate the rich who have been disappointed, or who have lost the hope of joining their number, but few others. "Have the multitude, whether in England or the United States, ever tried to limit wealth, or divide wealth, or confiscate wealth at death, or in any way whatever endeavored to cause wealth to cease to be? They have examples of such legislation before them all over the continent, but they not only do not carry similar measures, but they never ask for them, and would treat any candidate who relied upon them in his programme as either a mere faddist or an advocate of novel and disagreeable social heresies. . . . The truth is that both here and in America discontent, when it exists—and of course there is plenty of it—takes the self-pitying direction, and not the direction of envy. We remember, about five years ago, being much struck with the form taken by the discontent of a raging orator in one of the parks. He was boiling over with fury against the rich, and at last, rising to the height of his argument, he burst out into an apostrophe: 'You rich fellers, you have funds, you have bonds, you have railway shares: tell me, you wretches, why we should not have them too?' That, not the stripping of the rich, was the English rough's genuine and most hearty aspiration."

The Ways of Sparrows.—The habits of the London sparrow have been studied with much advantage by a writer in the London Spectator, who finds more method in the ways of the bird than we are usually apt to imagine. The site of the sparrows' nests is chosen with much care, and always with a view to avoiding the dangers from cats.

Hollows in the perpendicular wall faces of the building are preferred, but any proximity to the roof, where cats are liable to abound, is shunned. The nooks furnished in old houses advertised for sale or demolition, by the frames which are set upon them for bill posting, are much resorted to by the birds. The spaces between the frames and the walls are commodious nesting places. The under concavities of corrugated iron roofing furnish hundreds of ready-made tunnels under the cross beams, and when one of these roofs is built in a neighborhood, the sparrows will desert their old, now less attractive quarters "to a bird." "No cat can climb it or stretch a claw far enough up to hook out the nest." The London sparrow is intensely local. "He moves as seldom as he can from his own particular block of houses or square or terrace; and in the suburbs he keeps not only to his own house, but often to the back or front of the house only, not caring to circumnavigate his own suburban garden. In spring, when pulling crocus flowers to pieces becomes a mania with sparrows for a few days, it has been noticed that in many instances all the sparrows in the front of the house will take a fit of crocus-spoiling, while the flowers behind the house are let alone. Or the reverse may be the case, all those behind the house being spoiled, while the sparrows haunting the front of the house and front garden are occupied in some other sphere of activity. If an old nesting place is destroyed, the local birds at once seek another as close as possible to it."

Camphor.—Owing to the widespread use of camphor in the arts and in medicine, its increasing scarcity and expensiveness have raised the problem of artificial cultivation. There are a number of trees, many of them widely separated in genus, order, or species, from which camphor is obtained. The tree, however, which produces most of the camphor of commerce is the *Cinnamomum camphora*, a member of the laurel family, belonging to the same genus as the cinnamon tree. This tree attains enormous size. The bulk of the camphor imported into Europe comes from Japan and Formosa, and a small amount from China, although the trees are very abundant in the latter country, and the wood is much used. Every part of the tree is said to be useful, even the fruit being employed in the preparation of tallow. The statement that the large use of smokeless powder is responsible for the high price of camphor is denied by Sir Frederick Abel, who says that, while camphor was much used in the manufacture of smokeless powder in the early days, it was soon shown to have serious practical disadvantages, and its use has been to a large extent discontinued. It is, however, used for the conversion of collodion cotton into celluloid, and, in combination with various ill-smelling compounds, is the basis of most moth powders. In a recently published account of the commercial and scientific value of this tree Dr. E. Grassmann urges the importance of increasing the plantations to the greatest possible extent, and the placing of some restriction on the wanton destruction of the trees.

Evolution of the Storage Battery.—A recent article in the Journal of the Franklin Institute, by Maurice Barnett, on the Evolution of the Storage Battery, gives many interesting historical data. It seems that in 1801 Gauterot, while decomposing salt water electrolytically, noticed that on breaking the circuit he could obtain a current of short duration from the electrodes. A few years later Ritter constructed a pile consisting of disks of copper, separated by pads moistened with saline solution; after passing a strong current through this pile he was able to obtain a current of considerable intensity from the pile itself. This was practically the first storage battery. In 1859 Gaston Planté began a series of researches which led him finally to the elaboration of a practical storage battery. He electrolyzed diluted sulphuric acid with rods of the various metals used successively as electrodes. Lead gave the most promising results, not only on account of its capacity, but also because of the intensity of the discharge. Planté came to the conclusion, in 1859, that lead was the only useful metal, and then proceeded to construct his spiral accumulator, which consisted of two plates placed concentric with each other in dilute sulphuric acid, one plate being lead, the surface of which was peroxidized, the other, metallic lead. He got from this electric couple an E. M. F. of

about two volts. Having constructed his accumulator, Planté experimented with various methods of "forming" the plates that they might yield effects extending over a considerable interval of time. His method was to pass a current through the accumulator first in one direction, then in the other, and repeat this reversal many times with intervals of rest in between. The only current available for this work was that obtainable from a primary battery; this made the process a long and expensive one, but by its means currents of considerable density, lasting for a length of time depending on the extent to which the plates had been affected by the electrolytic process, were obtained. Between 1859 (when Planté began his experiments) and 1880, when Faure invented the pasted battery, great changes had taken place in the condition of the electrical arts and manufactures. The dynamo had been perfected, and offered means for the cheap production of currents of great density and high E. M. F., and hence gave a new stimulus to the production of a practical storage battery. Faure made pastes of red lead and litharge, which he applied to the surfaces of the positive and negative plates. When these were subjected to the forming process, the red lead was oxidized to peroxide and the litharge reduced to spongy lead, with a material saving in time and cost over the Planté process. Almost immediately accumulators were put to a variety of industrial uses, among which may be mentioned their application to carry the day load in lighting stations and to prevent the necessity for running dynamos at night in private residences. Even for traction purposes, where accumulators are subjected to the severest demands, their use was proposed as far back as 1880, and in 1883 a car went into service at Kew Bridge, London, equipped with a Siemens dynamo, set to run as a motor, and about four thousand pounds of batteries. The first storage battery put upon the market was, of course, crude, and the result was that in nearly all of its various applications it was a failure. The modern storage battery date: from the invention of Faure in 1880, and up to within a few years the pasted lead battery was the only form used to any extent. Recently the Planté type has again come into favor, together with an improved form of battery known as the chloride accumulator. The characteristics of the Planté type of battery are capability of giving heavy discharges without sustaining injury, minimum local action, and general freedom from the irregularities due to local action. The chloride battery takes its name from the fact that the active material of the plates is made from lead chloride rather than from metallic lead, as in the Planté, or lead oxide as in the pasted batteries. These cells show a high efficiency in practice, small deterioration, capability of holding a charge over considerable intervals of time, and freedom from short-circuiting, buckling, sulphating, or any of the troubles to which the old lead batteries were subject. They are thus seen to possess none of the defects of pasted batteries, while they embody all the merits of the Planté cells, without their faults of structural weakness and tedious formation. To-day the extension and use of the storage battery are looked on with growing favor.

Relations of Moisture and Vegetation.—M. Edmond Gain has found, in special researches on the subject, that the influence of moisture on vegetation varies at different periods of growth of the plant, and that alternations of moisture and comparative dryness are more advantageous to it than constant moisture. The plants that require constant moisture as a factor of their most vigorous growth are relatively few. Nearly all plants need water in order to secure vigor of growth, but require it at different intervals in certain precise stages of their vegetation; and plants which at one time take up water with advantage may suffer much from an equal supply at another time. As a rule, the need of water is urgent when the first leaves are appearing. It then diminishes till just before blossoming, when a large supply is called for. This should be suspended after the flowering season is over, for the fruit is best perfected in a relatively dry medium. If the plants blossom more than once, they need a new supply of water previous to the second flowering. In all the author's experiments those plants which were watered at the two critical seasons of first growth and the beginning of blossoming did as well as those which were constantly wa-

tered. M. Gain further found that moisture in the soil favors and increases the number of fruits and seeds, while a dry soil promotes larger and heavier seeds. Plants in dry soil have more roots than those in wet soil. While the tenure of moisture has little influence on the number of tubers, they are larger and heavier in a moist soil; yet they are less perfect than tubers grown under relatively dry conditions. Thus, while greater moisture is favorable to a larger immediate return, it is less promotive of perfection in the reproductive parts, and so favors the individual rather than the vigor of the species.

Geography in the Middle Ages.—The first number of Herr M. Konrad Miller's work on the Oldest Maps of the World is devoted to the map of the universe of St. Beatus, a Spanish theologian, who died A. D. 798. It was made in connection with the author's Commentary on the Apocalypse, to point out the regions assigned to the several apostles, and exists in many copies of different ages, the maps in which differ but little from one another. One of the most famous of these copies is the one called the Manuscript of St. Sever, in the Bibliothèque Nationale, Paris, of about A. D. 1050. The map includes the whole world in an oval inclosed by a blue sea border containing large and fierce-looking fishes and red objects which might be taken for red slugs, but which are really vessels. At the extreme east (north and south being at the ends of the axis of the oval) Temptation is represented in a naturalistic style. At the point where the earthly paradise was supposed to exist, Adam is bashfully making symbolical gestures, and Eve, bold and full of initiative, is picking the apple, both entirely naked. It appears clear as the light of the sun that all the wrong is on Eve's side. In the extreme west are Tangier and Cordova at the entrance of a sea that washes Majorca and Minorca, then Sardinia, Corsica, Cyprus, and Crete, and turns to the north in the Adriatic Gulf and the Hellespont. The Fortunate Islands, in the midst of numerous fishes, are Madeira and the Canaries, and, together with the British Isles and perhaps Iceland, mark the western limit of the world. In the south the Red Sea, bright scarlet, is separated from the Mediterranean by the whole of Egypt and Palestine in a way to defy the most enterprising isthmus-borers. No pains are taken to give the contours of the coasts, the bays, or the gulfs. Spain is reduced to a triangle, one side of which, curved, is formed by the Pyrenees, as if they were a fringe, while the other two sides are the shore, straight. The details of the geography of the several countries are curious, but can not be described here. Many strange things appear in Africa, too, while the origin of the Nile in a great lake is indicated in the clearest manner.

Origin of Honeydew.—M. Gaston Bonnier's studies of the formation of honeydew have led him to the conclusion that not only is it elaborated through the agency of aphides, but it is also exuded directly, under proper conditions, by the leaves of the trees. He has observed that under conditions of a considerable difference between the temperatures of the day and the night, when no insects can be found, a sugary liquid falls after sunset in drops from certain trees; and after wiping the leaf with absorbent paper, he found the minute droplets issuing from the stomata. This was observed on the epiceas, silver firs, Scotch pines, Austrian pines, oaks, maples, aspens, poplars, alders, birches, vines, and various herbaceous plants. Yet the aphides are the more frequent cause of the production of honeydew. Their work is done mostly in the daytime and is suspended during the night, while the direct production of honeydew takes place at night and ceases in the daytime. It is promoted by the interposition of cool nights between hot and dry days, and is favored by increase in hygrometric conditions and darkness. The exudation can be provoked artificially by dipping the branches into water and then placing them in the dark in a saturated atmosphere. Under these conditions the leaves may be caused to produce honeydew when those on the trees from which they were taken do not. Although bees will go to collect any sweet substance when they can get no better, they always prefer the best they can find. When mellifluous plants are blooming abundantly, they pass the honeydew by; but when mellifluous flowers are scarce, they gather honeydew. The chemical composition of honeydew is various; but that naturally exuded approaches that of the honey

of the nectaries more closely than does that elaborated by aphides.

Horse Racing in Bosnia.—The Bosnians are very fond of horse racing. Their meetings were kept up for five hundred years under the native laws, and are supported with still more splendor by the Austrian Government. The horse is the favorite companion of the native, who celebrates it in his songs, and cares for it as he would for a child, guarding it against the evil eye and malice. The Bosnian mountain horse possesses fine qualities, and is sober, agile, and hardy. Previous to being put in a race he is subjected to a very curious special training. For three or four weeks he is enveloped in thick coverings, and is bled repeatedly and thoroughly. He is walked all day, and especially in the evening and the morning, in the open air. No hay is given him, and as little as possible of barley and water. His legs are massaged time and again, and rubbed with a mixture of water, salt, and two yolks of eggs. He is given only a few hours of rest, and the treatment is kept up till the very moment of the race.

M. Daubrée.—By the death of M. Daubrée French geology has lost one of its most brilliant workers. Born at Metz on June 25, 1814, he soon developed a special interest in minerals. He passed in 1834 from the École Polytechnique into the *Corps des mines*. He already, while a student, began to display that breadth of view and width of sympathy which distinguished his later career. Gradually his attention was more and more directed to the experimental side of his favorite science. He studied the artificial production of various minerals, and entered upon a course of profound investigation in which he became the great leader, and did more than any other observer to advance that department of the science. The difficult problems of metamorphism had a peculiar fascination for him, and he devoted himself with admirable patience to the task of trying to solve some of them by actual experiment. The various researches collected in his Études synthetiques de Géologie experimentale have taken their place among the classics of modern science. He also devoted much time to the study of meteorites. His last important volumes discussed in detail the phenomena of underground water, and traced the various solutions and changes which water is now producing and has formerly effected within the crust of the earth. M. Daubrée spent the greater part of his scientific life in Paris, where he occupied official posts in the École des Mines and Muséum d'Histoire naturelle. He retired from office two or three years ago, but still continued to interest himself actively in scientific research. He was one of the most regular attendants of the Académie des Sciences, and one of the most influential members of that distinguished body, serving on many committees and taking an active part in all its concerns. He began to be somewhat ailing before last Easter, and, though for a time he appeared to rally and hopes were entertained that his life might still be prolonged, he died peacefully at his house in the Boulevard Saint-Germain on May 29th.

Cacao Cultivation in Mexico.—The cacao tree is a native of Mexico, and long before the conquest the Aztecs used the cacao bean in making a beverage which they called *chocolatl*. "All nations subjugated under the Aztec eagle had to bring, among other valuables, a certain number of bags of cacao to the palace in the great Tenochtitla as an annual tribute to the emperor. It was so highly prized among the ancient natives that in trade it was utilized as currency among the lower classes. The varieties cultivated were quauhcahuatl, mecacahuatl, zochicucahuatl, and tlacacahuatl." The tree grows wild and in cultivation in the States of Colima, Michoacan, Guerrero, Oaxaca, Chiapas, Tabasco, and central and southern Vera Cruz, where the elevation is from a hundred to twelve hundred feet above sea level. Chiapas and Tabasco, however, contain the most favorable climate and soil for the cacao tree, and the finest cacao in the world is grown in these two States. The species most cultivated in Mexico are cacao or *Theobroma ovalifolia*, *T. bicolor*, and *T. angustifolia*. A warm, moist climate, having a mean temperature between 76° and 77° F., is necessary for its most successful cultivation. The best elevation is from three to five hundred

feet, but the tree will not thrive if exposed to the direct influence of the sea breeze. The plants are propagated by means of the seed, which is simply covered with loam and some sort of fertilizer, and then the whole covered with banana leaves. The bed is sprinkled every day for twelve or fifteen days, when the seedlings appear. Then the banana leaves are removed, and sheds are erected over the bed, which serve as shade and shelter. A year after sowing, seedlings are about twenty inches high and ready for transplanting. The plants begin to yield remuneratively in about five years. The average annual yield of dry cacao from each tree varies greatly, but is somewhere between a pound and a half and eight pounds. The pods having been gathered are placed in heaps under the trees, to be subsequently taken to the *quelradero* where they are broken. The kernels or nibs are then taken out of the pods, which are either opened with a machete or a knife made from a wood called jahuate. The seeds are thrown into wooden troughs called *tollas* half filled with water to wash them, and the beans are then carried away to the cacao house for the sweating or fermentation process. After being properly sweated they are dried ready for shipment. It is stated that seven hundred and fifty trees will give the planter a net annual profit of more than $1,225.

MINOR PARAGRAPHS.

Prof. Dewar, in the first of a series of lectures on Chemical Progress at the Royal Institution, paid a well-deserved tribute to the pioneer work of M. Moissan, in his researches on the combination of carbon and the various metals in the electric furnace. Prof. Dewar also called attention to the fact that many years ago Mendeleef put forth the view that the immense localization of petroleum at Baku and other centers could only be accounted for on the theory that it was being continuously generated by the action of water on carbides. Benzene, which is the nucleus of all the colors hitherto obtained from coal tar products, is reached by the acetylene process in three stages: first, the combination of lime and coal in the electric furnace; second, the decomposition of the resulting carbide by water; and, thirdly, the transformation into benzene of acetylene gas by means of heat.

The catalogue of earthquakes in Russia, to which are added those in China, Persia, and other countries bordering on that empire, begun by A. Orloff, in 1869, and just completed and revised by Prof. Mushketoff, contains a list of abont 2,400 separate earthquakes which occurred in 560 places, between 596 B. C. and A. D. 1887. Of them, 710 took place in China, 549 in East Siberia, 36 in West Siberia, 202 in Central Asia, 590 in Caucasia, 121 in Asia Minor and North Persia, and 188 in European Russia. Considering only the periods during which the observations went on without interruption, the frequency of earthquakes may be represented as having been 640 in each hundred years in Caucasia, 310 in China, 290 in East Siberia and Turkistan, 138 in Middle and South Russia, and only 19 in North Russia, Finland, and the Baltic provinces. The date of the catalogue shows that while in Siberia and Central Asia earthquakes are more frequent during the autumn and winter than during spring and summer, the proportion is reversed for China and Caucasia.

The interdependence of the most unlike things in Nature is well shown by the following: It seems that in certain districts the growing of water cresses is quite an important industry. The caddis worm is very fond of water cresses, but is usually kept from doing them any serious damage by the trout, which it seems are very fond of the caddis. But during last season a large number of herons appeared, who have a special predilection for trout, which they thinned out to such a degree that the caddis worms were given a free course, and soon destroyed the water-cress crop. The loss of the water-cress grower was primarily due to ravages of the caddis worm; which ravages were due to the lack of trout; the lack of trout being due to the unusual number of herons present in the neighborhood, and the unusual number of herons was due to the men who encouraged their breeding and multiplication for other reasons. Thus we have a state of things

which at first sight seems to have arisen through purely natural causes, but which, upon closer inspection, is clearly traceable to man's interference with the "balance of Nature."

NOTES.

SOME recent experiments, says Industries and Iron, seem to indicate that iron is much weakened after being pickled and galvanized. A dozen eyebolts, all precisely alike, so far as could be perceived by external inspection, were carefully selected; six of these were laid to one side and the others sent away to be galvanized. When the galvanized bolts were returned the whole twelve were put together and tested, when it was found that the galvanized bolts were the ones to break; not in any instance did the ungalvanized ones give way.

ALTHOUGH Spitzbergen has been frequently visited, its coasts have been well surveyed, and it has even been a place of industrial and commercial importance, no attempt has been made to explore the interior of the main island. Mr. W. M. Conway purposes to supply the omission, and to lead a scientific party during the summer, who will make a thorough study of the land. The west island is penetrated by many fiords, and no part of it is more than twenty-five miles from the sea. The party will cross from fiord to fiord, and will be supplied from a steamer which will meet them at appointed places.

AS, in the rush of waves, the billows travel onward, the energy, Mr. Vaughan Cornish observes in Knowledge, is passed from point to point, silently and smoothly, till the leeward shore is reached. Here all is changed. On the one side is the swinging water, ever handing on the energy of its motion. On the other side is the dead resistance of the beach, to which each breaker as it falls yields up its store of energy. There is no finer display of natural forces than the rush of the waves on a rock-bound coast, when each billow as it nears the shore raises a steeper crest, and, dashing down in thunder on the rocks, throws upward and abroad a cloud of glittering spray, which falls in salt showers.

AFTER the bicycle comes the *celerette*, a modified revival of the old *draisienne*. It is a machine without pedals, and can be made very cheaply, with a wooden frame and even with wooden wheels, to which India-rubber tires may be added if desired. It is propelled by kicking with the feet upon the ground, and the activity and vigor required to keep it agoing depend on the character of the road. On a smooth, level road the work is light, and down hill the machine goes of itself. The advantage it offers is that of getting over the ground more rapidly and with less fatigue than by walking; but it is not likely to compete seriously with the bicycle.

THE smoke of a common wood fire has been found by M. G. Palozzi to be a very efficacious disinfectant, capable of destroying pathogenic germs suspended in the air or attached to walls and furniture, or hidden in drapery or clothing. The author recommends it as a convenient and very economical means of disinfecting sick-rooms or any other contaminated places.

THE Portuguese Government has decided to celebrate the four hundredth anniversary of the discovery of the route to the East Indies by way of the Cape of Good Hope, which was made by Vasco da Gama, July 8, 1497. It is understood that exhibitions and scientific congresses at Lisbon will form part of the proceedings.

AT last Darwin's suggestion that the boring of a coral reef is the wise way to settle its mode of formation is to be carried out. Prof. Sollas is in charge of an expedition which started last May from Sydney, fully equipped for boring one thousand feet if necessary, for the island of Funafuti, one of the Fiji group. This island is a typical atoll; it is about fifteen miles in circumference. The lagoon has a good entrance, and provides firm anchorage. The results of the expedition should be of great importance.

THE committee on public baths appointed by Mayor Strong recently submitted plans which provide for a bath house in Tompkins Square, and two smaller and subterranean lavatories—one under Main Street, and the other under Greeley Square, at the junction of Broadway and Sixth Avenue. These baths will be important agents in promoting public health, and have been sorely needed in New York city for years.

THE preparations for the British Association meeting in Liverpool next September are now going on rapidly. The meeting promises to be a very interesting one. A number of the owners of works of manufacturing and engineering interest have offered to open their buildings for inspection during the week, and numerous enjoyable social events are promised.

CAVALIERE CRISTOFORO NEGRI, whose death was recently announced, was a distinguished Italian scientist, and for many years a most enthusiastic promoter of geographical research. Born at Padua in 1809, he first devoted himself to the study of law; he held the post of Professor of Constitutional Law at Padua, but was after 1848 compelled to leave the city for political reasons. He was the founder, in 1866, and the first President of the Italian Geographical Society. He was for many years an honorary corresponding member of the English Royal Geographical Society.